Ohio Agricultural Experiment Station.

BULLETIN 108.

WOOSTER, OHIO, JUNE, 1899.

BOVINE TUBERCULOSIS.

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BULLETIN

OF THE

Ohio Agricultural Experiment Station.

NUMBER 108. JUNE, 1899.

BOVINE TUBERCULOSIS.

BY C. E. THORNE.

CONTENTS.

ACKNOWLEDGMENTS.

The experiments with tuberculin, reported in the following pages, were made by the Station Agriculturist, Mr. J. Fremont Hickman, with the assistance of Wm. Holmes and C. A. Patton, Farm Foremen, and Antony Russ, Herdsman, the tuberculin itself being furnished by Dr. D. E. Salmon, Chief of the Bureau of Animal Industry, Washington, D. C.

The data concerning the prevalence of bovine tuberculosis and municipal inspection of milk and meat in Ohio have been furnished by one hundred veterinarians and health officers, and those relating to infantile tubercular disease by three hundred and thirty-nine physicians, who have most kindly responded to circulars of inquiry on these points.

The numerous citations from the work of other stations have been acknowledged as made; but the copiously indexed volumes of the Experiment Station Record have been of great service in looking up the general literature of this subject. Running through the ten volumes of this publication there are now more than 200 references to publications on tuberculosis of animals, a large proportion of these references being accompanied with abstracts or summaries.

INTRODUCTION.

Tuberculosis is the generic name given to a class of diseases due to the growth within the body of a vegetable organism — the *Bacillus tuberculosis* — of which class the disease called consumption is the best known type. Tuberculosis is characterized by the deposit of grayish-white granules, which may be the size of a millet seed or smaller, or may be aggregated into larger masses, or tubercles. These masses or granules are at first red, congested and solid; gradually the color changes to gray, as the tissues become dead, and a cheesy mass is usually formed which becomes gritty through deposit of earthy salts and eventually softens into pus. In some cases, instead of forming a cheesy mass, the tubbercle develops into firm, rounded nodules, filled with calcareous deposit.

In cattle the disease frequently makes its first appearance in the pharyngeal, bronchial or mesenteric glands, and it may be confined to a single gland, or set of glands, for an indefinite period, before assuming a more generalized form.

In its first stages it is usually impossible to recognize bovine tuberculosis by ordinary methods of diagnosis. Sometimes the pharyngeal glands become so much affected as to interfere with breathing, when the disease may be suspected; but when the affection is confined to organs more deeply seated it may be months or years before its presence is made evident.

Coughing, which is so generally a symptom of pulmonary consumption in the human subject, is by no means a regular symptom of tuberculosis in cattle. When the lungs become much involved some coughing is to be expected, but in very many cases the liver and other organs may be affected long before the disease reaches the lungs. In fact, an animal may be to all external appearances in perfect health, with sleek coat and increasing weight, and yet be far advanced with tubercular disease.

In 1882 Dr. Robert Koch, of Berlin, demonstrated the true nature

of this disease by isolating the tubercle bacillus, and showing that the disease may be produced with equal certainty by inoculation from tuberculous material, or from pure cultures of this bacillus, grown on gelatine and entirely away from the animal body. He also showed that the tubercle bacillus, as found in the tubercular human subject, is identical in appearance with that found in tubercular animals, and that the disease may be produced at will in animals by inoculation with human tuberculous material.

With Jenner's great discovery in mind, Dr. Koch attempted to produce a substance which should have the effect of rendering the system immune to the tubercle bacillus. To this end he heated tubercular material until the germs were killed and strained it to remove their dead tissues, giving to the clear liquor thus obtained the name "Tuberculin."

His hope that tuberculin would prove a preventive or cure for tubercular disease was doomed to disappointment; but it has proved to be the next best thing, the most effective diagnostic of this disease, especially in its earliest stages, that has ever been discovered.

THE TUBERCULIN TEST.

The value of tuberculin as a diagnostic depends upon its property of causing an elevation of temperature in tuberculous cases in doses which produce apparently no effect whatever upon the healthy organism. In the use of this test upon animals the normal temperature is first ascertained by making several observations with the clinical thermometer; a hypodermic injection is then made of tuberculin of a given strength, the dose being graduated according to age and species of the animal, and after an interval of a few hours the temperature is again ascertained, observations being made at frequent intervals for ten or twelve hours. If a rise of temperature of two or more degrees occurs, beginning within 8 to 16 hours, usually 10 to 14 hours after the injection, and continuing for several hours, then tuberculosis is to be suspected, provided, of course, such sources of error have been avoided as sexual heat, approach of parturition, or undue exposure or excitement.

There are now on record many thousands of cases, both in America and Europe, in which the tuberculin test has been followed by slaughter and post mortem examination, and its diagnosis, whether positive or negative, has been so universally confirmed as to give to this test a place among the most accurate of diagnostics.

The tuberculin test was introduced into the United States in 1892, the tuberculin being imported from Dr. Koch's laboratory. The manufacture of tuberculin was soon undertaken by the Bureau of Animal Industry, U. S. Department of Agriculture, and is still continued by that Bureau, while it has also been undertaken by private firms. The Bureau of Animal Industry cannot sell tuberculin, but will supply it

without charge to public officials who have authority to destroy all animals found tuberculous. The tuberculin used in the investigations of this Station has been supplied by the Bureau, through the courtesy of its efficient chief, Dr. D. E. Salmon.

HOW TO MAKE THE TUBERCULIN TEST.

The essential apparatus for making the tuberculin test consists of three pieces: the clinical, or fever thermometer, the hypodermic syringe and either a graduated beaker or a graduated pipette. The clinical thermometer may be bought at any first class drug store, but should be accompanied with a certificate of accuracy.

The hypodermic syringe consists of two principal parts, the barrel with its piston, and the needle. It is well to have two needles, in order that one may be disinfected while the other is in use. The needle with a shoulder will be found useful for work on young animals, the shoulder

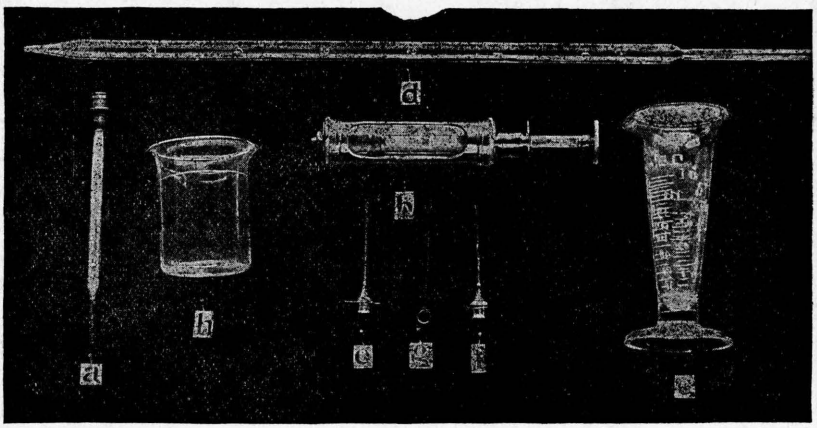


FIG. 1. INSTRUMENTS FOR MAKING THE TUBERCULIN TEST.

a. Clinical thermometer.
b. Hypodermic syringe.
c. Graduated beaker.
d. Graduated pipette.
e, *f.* Injecting needles.
g. Needle cleaner.
h. Small beaker.

preventing a too deep insertion of the needle; but for old animals, with a thick, tough hide, the shoulder is sometimes objectionable, as the point is not quite long enough to penetrate such hides to a sufficient depth to insure a perfect injection and it is not easy to push the needle past the shoulder. The point of the needle is made with cutting edges, which make a cut instead of a punctured hole.

Hypodermic syringes for veterinary use are sold by all dealers in veterinary supplies. Among other equally responsible houses are those of Haussman & Dunn of Chicago and John Reynders & Co. of New York. It is advisable to get nickle plated instruments, as they are less liable to be affected by carbolic acid than rubber mounted pieces.

As between the graduated beaker and the graduated pipette, the latter is much the more accurate instrument, but it requires a little practice to manipulate it successfully. The fluid to be measured is first drawn into the pipette by mouth suction, a finger is then quickly placed upon the upper end of the tube, and the liquid is allowed to flow back into the bottle slowly, by slightly lifting the finger, until the zero point is reached, after which it is permitted to flow into a small beaker (*h*) until the exact quantity required has run out, when the remainder is emptied back into the bottle again. For this purpose a chemist's beaker is much better than a teacup or tumbler, because the flat bottom makes it possible to draw up the liquid completely into the syringe, by tipping the vessel, whereas a rounded bottom would retain more of the fluid.

The graduated pipette, of which the 5 cubic centimeter size, graduated to tenths, is most convenient, may be bought of Eimer & Amend or Emil Greiner, New York, or other equally good houses, if it cannot be found at the local drugstore.

The dose of tuberculin, as prepared by the Bureau of Animal Industry, is 2 cubic centimeters for a thousand-pound cow, or in that proportion for animals of heavier or lighter weight.

After the exact quantity required for the dose has been measured out it is drawn up into the hypodermic syringe, the point of which has been first disinfected by dipping or letting it stand a few minutes in a solution of carbolic acid and then rinsing in pure water. It is well here to have an assistant to hold the beaker at such an angle that the syringe may draw out all the liquid. If the operator is skillful the point of the syringe may then be inserted through the skin — the point of the shoulder is the place usually selected, and it is better for the operator to stand on the opposite side of the animal from that on which the insertion is made, and reach over its back — and the contents carefully forced out, the skin being pinched up and drawn out a little with one hand, in order to prevent the liquid flowing back outside of the needle, while the syringe is manipulated with the other. As the animal is liable to flinch from the sting of the needle, however, it is better, for the amateur operator at least, to unscrew the needle, after filling the syringe, insert the needle first, then screw on the syringe and make the injection.

In filling the syringe care should be taken to avoid getting air into the cylinder, and in emptying it a steady pressure should be used.

As soon as an injection has been made the needle should be unscrewed and placed in a small cup containing a full strength solution

of crystals of carbolic acid, otherwise there may be danger of carrying germs of the disease from one animal to another.

In making the tuberculin test the first step is to determine the normal temperature of the animal. This is done by inserting the clinical thermometer into the rectum and letting it rest about three minutes, then withdrawing and reading carefully. It is well to have a string attached to the thermometer, thus permitting insertion of the instrument to its full length; otherwise it is liable to be broken by the tail. It should also be moistened or oiled before insertion and disinfected afterward. Where many animals are to be tested it will be economy to have two or three thermometers. These preliminary determinations of temperature should be repeated at intervals of two or three hours throughout an entire day. It has been our practice to begin at 6 or 8 o'clock A. M., and repeat the determination every two hours until 10 o'clock P. M., At 10 P. M. the injection is made. Beginning next morning at 6 A. M. the temperature is again read every two hours until 8 or 10 o'clock P. M.

The presence of tubercular disease is indicated by a decided rise in the temperature of the animal, following the injection of tuberculin. Ordinarily this rise of temperature begins within 10 to 14 hours after the injection, although in exceptional cases it may commence earlier or later. In the typical tuberculin reaction the temperature rises gradually until a maximum point from two to four degrees above the normal is reached, when it as gradually subsides again. In advanced cases, or after the test has been made several times, the rise of temperature may not exceed two degrees; but in the case of a fresh test, when there are no outward indications of disease, a rise not exceeding two degrees should not be accepted as sufficient evidence of disease. Care should also be taken to ayoid the periods of sexual heat, as these may cause a rise of two or three degrees in temperature and thus entirely obscure the effect of the tuberculin. Other causes of excitement, such as rapid driving, railroad transportation, or removal to strange quarters must also be avoided.

WHY DOES NOT TUBERCULIN PRODUCE FEVER IN THE HEALTHY ANIMAL?

The answer to this question is that it will produce fever if used in sufficiently large quantity. As tuberculin is a product of tuberculous growth, it follows that it is constantly being formed when such growth is taking place, and when the disease reaches its later stages the quantity of tuberculin produced is sufficient to cause the afternoon fever which is one of the characteristic symptoms of this disease, both in human and bovine subjects. While the disease is in its less active form, however, the system becomes gradually accustomed to the presence of the small amount of tuberculin produced, and the time comes when the ordinary dose of tuberculin fails to produce any reaction.

WILL NOT TUBERCULIN PRODUCE TUBERCULOSIS?

There has been a quite general fear that tuberculin might, of itself, produce the disease in a healthy animal, but a careful study of the nature of the disease must show that this fear is unfounded. As has been stated, the researches of Koch, which have been verified by many others, have shown that the disease, tuberculosis, is produced by the growth within the tissues of a living, vegetable organism, which has its laws of reproduction, as definite and fixed as those governing the reproduction of any other forms of life. In the preparation of tuberculin this organism is first killed by heat, and its dead tissues are then removed from the liquid, so that there is no possibility of transferring the germs of growth through the medium of tuberculin. This theoretical assumption has been verified by countless experiments, in which the tuberculin test has been used repeatedly on healthy animals, with no unfavorable results of any description.

AN OUTBREAK OF BOVINE TUBERCULOSIS AT THIS STATION.

The herd of cattle at this Station was established in 1894, by the purchase of a bull and two or three cows each of the Jersey, Guernsey, Holstein, Red Polled, Shorthorn and Polled Angus breeds. These cattle were all registered and were selected from various parts of the state, not more than one or two animals as a rule being bought of any single breeder.

At the time these purchases were made the idea was prevalent that the tuberculin test might be injurious to the health of the animal. Many cattle breeders feared that it might be the means of introducing tuberculosis into their herds, while others, better informed on this point, still were forced to admit that the possible after affect, upon the general health of the animal, of the introduction of a toxic poison, like tuberculin, was at that date unknown, since the tuberculin test had only been introduced into this country two years previously. For this reason the test was not insisted upon in the purchase of these cattle, but every other precaution was taken to secure sound animals.

On the Station farm they were, of course, given good care. They were kept in newly built stables, which were warm, and in our judgment were sufficiently ventilated. All the increase was retained, and by the spring of 1897 there were about 80 animals in the herd, all apparently in perfect health except two—a Shorthorn cow and a Jersey bull, which had begun to show evidences of disease; the cow by rapid loss of flesh, and the bull by the growth in the throat of a visible lump, which caused difficulty in breathing.

At the beginning of June both these animals were killed, after having been subjected to the tuberculin test. The cow was found to be in the

last stages of generalized tuberculosis, and the lump in the bull's throat was found to be due to the same disease. A supply of tuberculin was then procured from Dr. D. E. Salmon, Chief of the Bureau of Animal Industry, and on June 15 to 17, thirty animals were subjected to the tuberculin test, with 14 cases of reaction. On September 7 and 8 these 14 animals were re-tested, with reactions in every case. In December and January further tests were made, and on June 8, 1898, fifteen cattle were slaughtered under the inspection of an officer of the Bureau of Animal Industry.

TABLE I—TUBERCULIN RECORD OF CATTLE

No.	Name.	Age years.	Temperature before injection.							
			Date.	8 a. m.	10 a. m.	12 m.	2 p. m.	4 p. m.	6 p. m.	8 p. m.	10 p. m.
1	Ohio's Vexer	4	May 24, '97	101.	101.	101.	101.5	103.	**104.2**	**107.**	**104.8**
2	Lady Challenger 2nd	6	May 24, '97	102.5	103.	103.5	103.8	**104.**	**104.**	**104.8**	**104.8**
3	Portia.....	6	June 15, '97	.....	100.2	101.	101.2	101.2	101 5	101.8	102.
			Sept. 7, '97	99.6	99.2	100.4	101.	101.	101.	101.	103.
			May 23, '98	102.2	102.6	103.6	102.8	103.6	103.	102.2	103.6
4	Viola.....	6	June 15, '97	.....	101.	101.2	102.5	102.	102.4	102.2	102.2
			Jan. 10, '98	101.8	102.6	102.	102.4	102.	101.2	101.2	101.6
			May 23, '98	101.2	102.	101.8	102.	102.	102.	102.	101.8
5	Nightingale	10½	June 15, '97	.....	101.2	101.8	101.8	102.6	102.6	102.8	102.4
			Dec. 28, '97	102.6	103.8	103.2	103.6	102.2	102.2	102.4	102.
			May 23, '98	101.4	101.8	101.8	102.	102.6	101.6	102.6	101.6
6	Fanny Daw 3d.....	6	June 15, '97	.....	101.2	101.	101.2	102.4	102.6	102.2	101.6
			Dec. 28, '97	101.6	102.8	101.4	102.8	99.	.....	100.8	100.6
			May 23, '98	101.8	101.8	101.8	102.2	102.6	101.	101.4	102.2
7	Nervilette	7	June 17, '97	101.	101.	101.	101.	100.2	101.8	101.	101.4
			Sept. 7, '97	99.4	100.4	101.	101.8	102.	102.4	102.2	101.8
			May 23, '98	101.	101.8	101.8	101.8	102.	100.4	100.6	100.
8	Nervilette's First ..	2	June 15, '97	.....	101.	101.5	101.5	101.5	102.	102 4	101.8
			Sept. 7, '97	100.6	100.6	100.8	101.8	102.	101.6	102.2	102.2
			May 23, '98	101.6	102.	102.4	102.8	102.6	100.8	101.8	101.2
9	Lorella....	7	June 17, '97	101.6	101.2	101.4	102.	100.8	101.6	101.	101.2
			Sept. 7, '97	101.	101.4	101.	101.2	102.	101.8	102.2	102.
			May 23, '98	102.	101.4	101.6	101.6	102.6	101.6	102.	101.4
10	Lorella's First	3½	June 17, '97	101.2	101.2	101.6	101.	101.4	101.	102.	101.
			Sept. 7, '97	100.6	101.2	101.	101.2	101.4	102.6	102.6	102.4
			May 23, '98	101.8	101 8	102.6	102.6	102.6	103.	102.2	102.6
11	Lorella's Second...	2½	Dec. 22, '97	99.8	101.4	101.4	101.6	100.8	101.4	101.	100.2
			May 23, '98	101.2	101.6	102.	102.	102.6	102.2	101.4	102.
12	Miami's First.....	3	June 17, '97	101.6	101.8	102.	102.	101.6	102.	102.2	102.
			Sept. 7, '97	100.4	101.2	101.2	101.	101.2	102.	102.2	102.
			May 23, '98	101.	101.8	102.	102.	102.6	101.8	101.2	101.6
13	Peterina's Second...	3	June 17, '97	.....	.....	.....	102.2	102.2	102.	101.8	101.6
			Sept. 7, '97	101.	101.	101.	101.2	101.4	101.6	101.2	101.
14	Jolly Boy.....	4	June 17, '97	.....	.....	.....	101.4	101.2	101.2	101.	101.
			Sept. 7, '97	100.	99.	99.	99.8	101.	100.6	100.	100.2
15	Levi Tom	4¾	June 17, '97	.....	.....	.....	102.2	102.2	102.2	102.	102.
16	Fancy's First.....	2½	Dec. 22, '97	102.4	103.2	102.8	103.	102.4	102.4	102.6	102.4
17	James' Cow....		June 15, '97	.....	101.	101.	101.	101.2	101.4	101.6	101.4
18	Mahomet's Rur'l Lass	9	June 15, '97	.....	101.	101.6	101.8	102.4	103.	103.2	103.4
19	Orphia 2nd.... ...	8	June 15, '97	.....	101.	101.4	101.2	101.6	101.6	102.	102.
			May 23, '98	101.6	101.2	102.2	102.2	102.	101.2	102.	101.8
20	Teeny's Fancy ...	6	June 17, '97	101.6	101.	101.2	101.	101.	102.	101.	101.4
21	Miami's Fifth.....	5 mos.	July 12, '98	103.4	102.2	104.	103.4	103.4	103.2	103.6	.....
22	T. S. Miami..	4 mos.	July 12, '98	103.2	102.6	102.6	102.6	102.4	103.	102.6	.....
23	Phillips' calf		Aug. 29, '98	102.	102 8	103.	102.6	102.4	103.	103.	.....
24	Nightingale's Fourth	3 mos.	July 18, '98	105.0	104 6	104.6	105.0	105.0	105.4	105.0	.....

Table I gives the tuberculin record of the two cattle first killed at the Station, of the 15 killed in June and of several other animals upon which there has been opportunity to test the accuracy of the tuberculin diagnosis by post mortem examinations.

NOTES.

Ohio's Vexer: Jersey bull, 4 years old. The temperature record shows an abnormal elevation in the afternoon previous to the injection of tuberculin,

KILLED PREVIOUS TO APRIL 11, 1899.

Date.	Temperature after injection.									Live weight at slaughter.	No.
	6 a. m.	8 a. m.	10 a. m.	12 m.	2 p. m.	4 p. m.	6 p. m.	8 p. m.	10 p. m.		
May 25, '97	101.2	102.2	**104.2**	**106 8**	**107.**	**106.5**	**106.**	**105.5**	**104.**	.....	1
May 25, '97	**104.8**	**104.2**	**104.**	**104.**	**104.2**	**104.2**	103.5	104.	103.5	.....	2
June 16, '97	100.8	100.6	101.6	102.	**105.4**	**104.**	103.8	103.2	....	.....	3
Sept. 8, '97	100.6	100.8	102.	**104.4**	**105.4**	**105.2**	103.8	103.	102.8	.....	
May 24, '98	101.8	101.8	103.6	103.8	**105.4**	**105.8**	**106.**	**105.4**	**104.6**	1379	
June 16, '97	101.	101.2	102.2	101.4	101.2	101.2	101.8	.....	.....	.....	4
Jan. 11, '98	101.4	101.8	102.	103.2	**104.2**	**105.2**	**105.**	**104.8**	**104.6**	.....	
May 24, '98	101.4	102.	102.	101.8	101.6	101.6	102.	102.	101.8	1053	
June 16, '97	101.5	101.	101.8	101.6	101.	102.	102.4	.....	.....	.....	5
Dec. 29, '97	102.8	**105.**	**107.4**	**107.4**	**105.8**	**103.**	**104.6**	**105.4**	**105.**	.....	
May 24, '98	102.8	**104.8**	**107.**	**106.8**	**105.6**	**104.6**	**104.8**	**104.8**	**105.**	942	
June 16, '97	101.2	101.2	101.	101.	101.4	102.	102.2	.....	.....	.....	6
Dec. 29, '97	101.2	101.4	102.8	103.8	**106.**	**104.8**	103.2	102.4	102.	.....	
May 24, '98	101.6	101.2	102.4	103.2	103.8	102.8	102.4	102.2	102.	1186	
June 18, '97	101.	101.2	101.2	102.6	**105.**	**104.**	**104.2**	**105.2**	.....	.....	7
Sept. 8, '97	**104.6**	**106.**	**106.2**	**105.8**	**106.6**	**105.6**	**105.**	**105.**	**104.**	.....	
May 24, '98	101.4	102.6	**105.**	**106.2**	**104.8**	**103.2**	**103.8**	**104.2**	**104.8**	707	
June 16, '97	**105.**	**104.8**	**105.2**	**105.8**	**104.**	**105.6**	**105.**	103.6	....	.....	8
Sept. 8, '97	**105.**	**106.4**	**106.**	**105.6**	**105.**	**106.6**	**107.4**	**106.8**	**106.**	.....	
May 24, '98	102.8	**104.**	**106.8**	**107.**	**105.6**	**104.6**	**103.6**	**104.8**	**105.4**	760	
June 18, '97	101.2	102.	102.8	103.	103.6	103.	102.4	102.	.....	.....	9
Sept. 8, '97	102.4	102.4	102.6	103.8	**104.6**	**104.2**	103.8	103.8	103.	.....	
May 24, '98	101.2	101.2	103.4	**106.2**	**106.8**	**106.**	**104.**	**104.2**	102.	1154	
June 18, '97	102.	103.4	**104.**	**105.8**	**105.2**	**105.**	102.6	103.	....	.....	10
Sept. 8, '97	**105.2**	**105.8**	**106.**	**105.6**	**105.4**	**105.4**	**104.4**	103.	102.	.....	
May 24, '98	101.6	102.2	**104.4**	**106.4**	**105.8**	**106.**	**104.**	103.6	102.8	970	
Dec. 23, '97	**105.**	**106.3**	**107.**	**105.2**	**106.4**	**105.6**	**106.**	**105.4**	**104.**	.....	11
May 24, '98	**104.6**	**106.2**	**104.2**	**104.**	**105.**	**105.**	**104.2**	**104.**	**104.8**	949	
June 18, '97	101.8	**104.8**	**105.6**	**104.2**	**104.**	**104.**	**105.8**	103.4	.....	.....	12
Sept. 8, '97	103.6	103.6	**104.**	103.4	103.4	103.6	103.6	103.	102.6	757	
May 24, '98	101.4	101.4	102.2	104.2	**105.6**	**105.4**	**105 4**	**105.6**	**105.4**	.....	
June 18, '97	103.4	**104.6**	**105.**	**103.**	**106.6**	**105.2**	**104.8**	**106.**	....	.....	13
Sept. 8, '97	103.	**104.2**	**105.4**	**106.**	**105.8**	**105.**	**105.6**	**105.2**	103.6	1910	
June 18, '97	102.	103.6	103.8	**105.4**	**106.**	**105.8**	**104.**	**104.8**	....	.....	14
Sept. 8, '87	100.	101.2	103.	**104.**	**105.2**	**105.2**	**105.6**	**104.8**	**104.**	1750	
June 18, '97	101.4	101.2	101.2	101.8	102.	102.	101.6	101.4	.....	1435	15
Dec. 23, '97	102.4	103.2	**104.4**	**104.8**	**106.4**	**104.2**	**105**	**104.8**	**104.6**	1129	16
June 16, '97	101.2	100.6	101.4	101.	101.	101.	101.6	.....	.....	.....	17
June 16, '97	101.2	101.8	100.6	101.6	102.	102.8	102.4	.....	.....	.....	18
June 16, '97	100.6	101.	102.2	102.2	102.6	102.6	102.	.....	.....	.....	19
May 24, '98	101.4	101.6	102.2	102.4	102.4	102.6	102.4	103.	102.	.....	
June 17, '97	101.	101.	101.6	101.	101.	100.8	101.4	101.2	.....	.....	20
July 13, '98	.....	**105.**	**104.2**	**105.4**	**104.**	**104.2**	**104.8**	**104.2**	.....	.....	21
July 13, '98	.....	**104.8**	**105.2**	**105.4**	**105.4**	**105.8**	**105.6**	**105 2**	.....	.....	22
Aug. 30, '98	.....	103.8	**104.2**	**106.4**	**106.2**	**106.2**	**106.4**	**106.8**	.....	.....	23
July 19, '98	.....	104.6	103.0	104.2	104.6	105.	104.8	104.8	.....	.....	24

which was exceeded in duration, but not in elevation, on the day following. The case was one in which the disease was making rapid progress, and diagnosis by physical inspection was easy, although the animal was still fat.

Lady Challenger 2nd: Shorthorn cow, 6 years old. In this case there was the same abnormal temperature before injection as that noted afterwards, the only difference being that the fever began earlier in the day on the day following the injection of tuberculin. In this case the disease was in its last stages, the animal being at the point of death. The daily afternoon fever noted in these two cases is a common symptom of the later stages of consumption.

Portia: Polled Angus cow, 6 years old at first test. This cow gave the distinct tuberculin reaction at each of the three tests made. The autopsy showed tubercular disease in the post-pharyngeal, bronchial and mediastinal glands, in the liver, stomach and right side of udder. Carcass condemned.

Viola: Red Polled cow, 6 years old at first test. This cow gave no reaction at the first test but showed a plain reaction at the second test. On May 24 she again failed to react, and when killed was found affected in the bronchial and lymphatic glands only, and the carcass was passed as sound.

Nightingale: Shorthorn cow, about 10½ years old at first test. This cow passed the first test but gave decided reactions at the two tests following. Tubercular nodules were found in both lungs and on bronchial and mediastinal glands and lymphatics. Carcass condemned.

Fanny Daw 3rd: Holstein cow, 6 years old at first test. This cow passed the first test, gave distinct reaction at the second, and showed a slight rise of temperature at the third. She was found to be tuberculous in the post-pharyngeal glands, lymphatics, bronchial glands and left lung. Carcass condemned.

Nervilette: Jersey cow, 7 years old at first test. Reacted distinctly at each of the three tests and found tuberculous in left lung, bronchial and prepectoral glands, mediastinal glands badly diseased, small intestines and both pleural surfaces affected. Carcass condemned.

Nervilette's First: Jersey cow, 2 years old at first test. Gave marked reactions at each test and found affected in the post pharyngeal glands, lymphatics, bronchial glands, anterior lobe of left lung, mediastinal glands and left pleural surface, with two abscesses on liver. Carcass condemned.

Sorella: Guernsey cow, 7 years old at first test. Passed the first test with but slight rise of temperature, but gave distinct reactions at both the following tests. Right lung badly diseased, and tubercles on post-pharyngeal, prepectoral and mediastinal glands, liver and both pleural surfaces. Carcass condemned.

Sorella's First: Guernsey cow, 2 years old at first test. Reacted distinctly at each test and found affected in intestinal, lymphatic and mammary glands; peritoneum and liver badly diseased. Carcass condemned.

Sorella's Second: Guernsey heifer, 2½ years old at first test, made December 23-24. Gave distinct reaction at this test and again in May, and found tuberculous in post-pharyngeal, prepectoral and mediastinal glands, lung tissue and intestines, large and small. There were three abscesses on lungs and a large quantity of pus in liver. Carcass condemned.

Miami's First: Guernsey cow, 3 years old at first test. Reacted distinctly at the first and last test, with a considerable rise of temperature at the second test. Found tuberculous in lymphatics, mediastinal glands, stomach, small and large intestines, left peritoneum and right pleura, with abscess and nodules on spleen. Carcass condemned.

Peterina's Second: Holstein bull, 3 years old at first test. Reacted distinctly in June and September, 1897. Killed in June without further testing, and found tuberculous in posterior mediastinal glands only.

Jolly Boy: Red Polled bull, 4 years old at first test. Gave well marked reactions at the tests of June and September. Killed in June without further testing and round tuberculous in bronchial glands and both lungs. Carcass condemned.

Levi Tom: Guernsey bull, nearly 5 years old at first test. Passed the test of June, 1897, as sound. Killed without further test and found affected in submaxillary glands. In this case there had been ample time for infection to take place between the test and the slaughter.

Fancy's First: Polled Angus cow, 2½ years old when tested, December 22–23, 1897. Reacted distinctly to the test, and found tuberculous in bronchial glands only.

James cow: A grade cow, of unknown age, fattened for beef. Tested in June, 1897, without reaction, and found free from tuberculosis when killed a year later.

Mahomet's Rural Lass: Holstein cow, 10 years old at the test of June, 1897, which she passed without reaction. This cow died on January 1, 1898, after having been sick about 4 weeks, and down nearly two weeks. On autopsy the gall bladder was found much enlarged but no sign of tubercle was discovered.

Orphia 2nd: Holstein cow, 8 years old at first test. Passed the tests of June, 1897, and May, 1898, without reaction, but died the first week in October, 1898, with symptoms similar to those shown by Mahomet's Rural Lass.

Teeny's Fancy: Jersey cow, 6 years old. Passed the test of June, 1897, without reaction, but died of parturient fever the following August. Careful autopsy was made but no sign of tubercular trouble was found.

Miami's Fifth and T. S. Miami: These were two Guernsey calves from tuberculous dams (Miami's Maid and Miami's First). They sucked for three days after birth and were then fed on pasteurized milk. They were killed July 16, 1898, when 5 and 4 months old, and both were found tuberculous in pharyngeal and bronchial glands, and the latter also in mediastinal glands, lungs and pleura.

Phillipps calf: A grade Jersey bull calf, from a cow which has never reacted to the tuberculin test. The calf was dropped May 28, 1898, and fed for four months on the untreated milk of the tuberculous cows. The calf was then killed and a large mass of tubercle was found on the pharyngeal glands, but no indications elsewhere.

Nightingale's Fourth: A Shorthorn calf, killed because of the high temperature shown both before and after the injection of tuberculin on July 18, but no tuberculous lesions were found.

The general condition of the 14 tuberculous cattle killed June 8, 1898, is indicated by Table II, which gives their monthly gain or loss in live weight for the 5 months preceding the slaughter, their weight on May 30 and the yield of milk from the cows on May 10.

In selecting the cattle for the slaughter test of June 8, seven cows and a bull, which had reacted to the tuberculin test, were reserved for further investigation. These cattle were kept separate from the remainder of the herd and were subjected to the tuberculin test at intervals of one or two months from that time until April, 1899. When these animals were thus set aside they were apparently all in good condition, showing no outward sign of disease.

One of the cows, however, "Miami's Maid," a Guernsey, 7 years old, soon began to show signs of ailing. She became very much emaciated, while her udder became swollen and very hard. She finally got

down and was unable to get up and was killed the 12th of August. The udder was found to be nearly a solid mass of tuberculous growth, and the lungs and pleural surfaces were also affected.

The tuberculin record of this cow is given in Table III. It will be observed that she gave well marked reactions to the tuberculin test in June and September, 1897, but that in the tests of May and June, 1898, there was an elevation of several degrees in temperature in the afternoon previous to the tuberculin injection, and a similar elevation the following

TABLE II—CONDITIONS OF CATTLE SLAUGHTERED JUNE 8, 1898.

No.	Breed.	Age at slaughter.	Monthly gain or loss (—) in live weight.						Weight May 30, 1898.	Milk yield May 10, 1898.	Extent of disease at autopsy.
			Jan.	Feb.	Mch.	Apr.	May	Total.			
		Years	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	
3	Polled Angus.	7	15	71	10	....	18	114	1379	12	Gen'lized.
4	Red Polled ...	7	46	10	–8	....	–39	8	1053	30	Local.
5	Shorthorn....	11½	103	20	33	*	–57	99	942	23	Gen'lized.
6	Holstein.....	7	22	67	56	27	21	193	1186	45	"
7	Jersey	8	.....	4	15	11	–38	–8	707	21	"
8	Jersey.....	3	24	.....	22	26	–3	69	760	16	"
9	Guernsey.....	8	42	27	26	55	2	152	1154	12	"
10	"	4½	34	54	42	20	21	171	970	10	"
11	"	3½	69	42	34	34	.....	179	949	20	"
12	"	4	26	14	.....	26	13	79	757	16	"
13	Holstein.....	4	47	97	94	28	14	280	1910	.....	Local.
14	Red Polled ...	5	23	65	49	34	40	211	1750	. ...	Gen'lized.
15	Guernsey....	5½	28	–2	9	63	–8	90	1435	.. ...	Local.
16	Polled Angus.	3½	. ...	77	68	37	–8	174	1129	9	Local.

* Dropped a calf.

afternoon, indicating that the disease had by this time progressed to a point where the afternoon fever of consumption was becoming manifest. On February 6, another cow of this lot, May of Edgewood, a Jersey 8½ years old, was killed when in the last stages of puerperal fever, and was found to be tuberculous in both lungs, with considerable cheesy matter and pus and a large abscess in the right lung. The tuberculin record of this cow is given in Table IV, and in this case we have similar symptoms to those shown by "Miami's Maid." In the tests of the first year we have the characteristic tuberculin reaction, but in the later tests this reaction is more or less obscured by the general tendency to increase of temperature, especially of afternoons.

On April 11, 1899, the remaining 6 animals of this lot, together with 5 others which had either reacted distinctly to the tuberculin test or had shown a rise of temperature in the test which left us in doubt as to their

condition, were killed in a public slaughter on the Station grounds, to which veterinarians and other interested had been invited. The tuberculin record of these animals is given on the following pages, as also their condition, as found on autopsy by Dr. David S. White, Dean of the College of Veterinary Medicine, Ohio State University, who conducted the post mortem examinations at the request of the Station.

TABLE III—No. 25—MIAMI'S MAID: Guernsey cow; 6 years old at first test.

Date.	Temperature before injection.								
	8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	Average.
1897, June 17	101.	101.6	101.	102 2	101.6	101.2	102.2	102.	101.6
1897, Sept. 7	100.	101.	101.	101.4	101.2	101.4	102.	102.	101.2
1898, May 23	101.	101.8	102.	102.2	**104.8**	**104.2**	**104.2**	102.8	102.6
1898, June 30	101.4	101.2	101.4	101.8	102.2	**103 2**	**103.6**	**103.2**	102.2

	Temperature after injection.									
	6 a.m.	8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	
1897, June 18.	103.6	102.	102.8	**104.2**	**104.4**	**104.**	102.2	101.4	.....	.....
1897, Sept. 8.	103.8	**104.**	**104.**	**104.6**	**103.8**	103.	102.8	102.8	.....	.....
1898, May 24.	100.8	101.4	101.6	102.6	102.	102.2	103.4	**104.**	**104.4**	.....
1898, July 1.	....	102.	102.4	101.6	101.4	101.6	102.4	**104.6**	**104.**	.....

TABLE IV—No. 26.—MAY OF EDGEWOOD: Jersey cow, 7 years old at first test.

Date.	Live weight.	Temperature before injection.								
		8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	Average
1897, June 17.	....	100.4	101.2	101.	101.6	101.4	101.	101.6	101.	101.2
Sept. 7.	.....	100.8	100.8	101.	101.8	102.2	102.2	101.	103.	101.6
1898, May 23.	849	100.8	101.	102.	102.	102.	100.8	101.2	100.4	101.3
June 30.	880	101.2	101.8	101.6	101.4	101.4	102.6	102.4	102.2	101.8
Aug. 29.	.....	102.2	102.	103.2	102.4	102.2	103.	102.8	.....	102.5
Oct. 3.	927	101.2	102.4	102.2	103.4	**104.4**	**104.8**	**104.6**	**104.**	**103.4**
Oct. 31.	943	101.4	102.4	102.4	**103.**	**103.**	**103 4**	**103.**	**103.**	102.7
Dec. 2.	997	102.8	102.8	102.2	102.8	**103.2**	102.	102.6	102.4	102.6
1899, Jan. 2.	996	101.6	101.6	102.	102.6	101.6	101 8	102.2	102.8	102.
Feb. 2.	995	....	....	....	102 4	102.2	**103.**	102.	101.4	102.2

Date.	Temperature after injection.									Quantity injected.
	6 a.m.	8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	
1897, June 18.	99.	102.2	100.8	103.2	**104.**	**106.**	**105.2**	101.	.....	2 c. c.
Sept. 8.	103.8	**104.2**	**104.**	103.8	103.8	103.4	103.8	103.8	103.	2 c. c.
1898, May 24.	102.2	**104.4**	**106.6**	**106.2**	103.6	102.2	103.2	101.4	101.2	2 c. c.
July 1.	....	101.8	102.8	102.	102 6	103.4	**104.6**	**105.2**	103 8	2 c. c.
Aug. 30.	.....	101.	101.2	102.2	102.2	103.6	**104.8**	**105.**	.....	2 c. c.
Oct. 4.	.....	101.	101.8	101.8	102.	102.8	103.2	103.2	103.4	2 c. c.
Nov. 1.	.....	102.	**104.**	103.2	103.	102.8	103.	103.4	103.	2 c. c.
Dec. 3.	.....	102.8	103.	**104.**	103.8	103.2	103.4	103.2	102.4	2 c. c.
1899, Jan. 4.	.....	102.	103.	103.	**104.**	103.4	103.	103.4	103.8	2½ c. c.
Feb. 3.	....	102.	101.6	101.8	101.6	101.6	102.	101.4	101.	3 c. c.

TABLE V—No. 27—GRETTA THORNE'S FIRST: Holstein cow, 3 years old at first test.

Date.	Live weight.	Temperature before injection.								
		8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	Average
1897, June 15.	..	.....	101.	101.2	101.8	101.8	102.2	102.4	101.8	101.7
Dec. 28.	867	102.	101.4	102.8	100.	102.	101.2	101.8	101.	101.5
1898, May 23.	1102	101.8	102.2	101.8	101.4	101.6	102.	102.	102.8	102.
June 30.	1198	100.8	100.4	101.6	102.	102.4	**103.4**	**103.4**	102.6	102.1
Aug. 29.	.....	102.	101.2	102.	102.2	102.8	**103.2**	**104.**	.....	102.5
Oct. 3.	1256	101.8	101.6	102.4	**103.4**	**104.6**	**103.8**	**104.2**	**103.**	**103.1**
Oct. 31.	1232	101.6	102.	102.8	102.8	**103.4**	102.6	101.6	101.4	102.2
Dec. 2.	1011	102.2	102.4	102.	102.8	101.4	101.4	101.2	100.6	101.7
1899, Jan. 2.	1003	100.8	101.4	102.	**103.**	101.	101.	101.4	101.2	101.5
Feb. 2.	961	102.	101.8	102.2	102.2	100.	101.2	101.	100.6	101.4
Mch. 2.	1004	102.	102.6	102.6	102.4	**103.**	102.	102.	101.4	102.2
Mch. 28.	1017	101.4	101.4	101.2	101.4	101.6	102.	101.2	101.2	101.5

	Temperature after injection.									Quantity injected.
	6 a.m.	8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	
1897, June 16.	101.2	101.6	101.8	101.6	102.	102.	102.4	.....	.....	2.0 c. c.
Dec. 29.	101.6	102.6	**104.**	**105.4**	**104.**	100.6	101.	101.4	101.8	2.0 c. c.
1898, May 24.	101.4	102.	102.2	102.	101.8	101.6	102.6	101.8	102.	2.0 c. c.
July 1.	.....	101.2	101.8	101.6	102.8	102.2	103.4	**104.**	**104.**	2.0 c. c.
Aug. 30.	101.2	101.2	102.8	102.4	103.	103.4	.....	103.	.....	2.0 c. c.
Oct. 4.	.....	102.2	102.	102.8	102.6	103.	103.2	104.	103.4	2.0 c. c.
Nov. 1.	.....	101.	101.6	101.8	102.	101.4	101.6	.....	.....	2.0 c. c.
Dec. 3	.....	101.4	102.8	102.2	103.	101.2	102.	101.4	101.2	2.0 c. c.
1899, Jan. 3.	.....	101.6	102.	102.8	103.4	102.8	102.4	103.4	102.8	2.5 c. c.
Feb. 3.	.....	102.	102.4	102.8	103.6	103.2	**104.**	**104.2**	**104.**	3.0 c. c.
Mch. 3.	.....	101.8	101.8	101.6	101.6	101.8	102.	101.8	101.	3.0 c. c.
Mch. 29.	.....	101.4	102.	101.2	101.4	101.2	101.8	101.6	101.2	3.0 c. c.

No. 27 dropped a calf December 2, 1897, and another November 1, 1898. On December 29, 1897, she apparently gave a clearly marked reaction to the tuberculin test. In the tests of May 23–24, following, there was no evidence of reaction, but in the next three tests there were abnormal afternoon temperatures, both preceding and following the tuberculin injection, and again in that of February 2–3, 1899, there was a distinct reaction. The autopsy revealed no indication of tubercular or other disease, and we must conclude either (1) that the test had failed in this case or (2) that the disease was actually present, but was overlooked, (the brain was not examined) or (3) that the cow had suffered an attack of the disease but had recovered.

TABLE VI—No. 28—LADY FEHL: Shorthorn cow, 9 years old at first test.

Date.	Live weight.	Temperature before injection.								
		8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	Average.
1897, June 15.	.....	... .	101.	101.5	101.8	102.4	102.6	102.2	102.	101.9
Sept. 7.	.....	99.	98.8	99.4	101.	100.6	101.	101.	101.	100.2
Dec. 28.	1151	102.6	101.4	103.	101.6	...	.....	100.8	101.	100.5
1898, May 23.	1294	101.2	102.	101.4	101.6	102.4	101.2	102.	101.8	101.7
June 30.	1410	101.6	101.6	101.6	101.6	102.2	102.6	102.8	102.8	102.1
Aug. 29.	.....	101.4	101.6	101.6	101.8	102.6	103.2	103.	.....	102.2
Oct. 3.	1409	101.4	103.4	102.2	103.2	102.6	102.4	103.	103.4	102.7
Oct. 31.	1422	102.2	101.8	102.	102.	102.4	102.8	102.	102.4	102.2
Dec. 2.	*1250	101.4	101.6	101.8	102.2	101.4	101.6	101.2	101.2	101.5
1899, Jan. 2.	1234	101.6	101.	101.6	101.8	102.4	102.	101.2	101.6	101.6
Feb. 2.	1180	101.	101.6	101.8	102.4	101.6	101.4	101.	101.4	101.5
Mch. 2.	1220	102.2	102.2	102.	102.6	102.6	102.4	102.	102.4	102.3
Mch. 28.	1266	101.8	101.2	101.	100.8	101.2	10.3	101.8	101.8	101.6

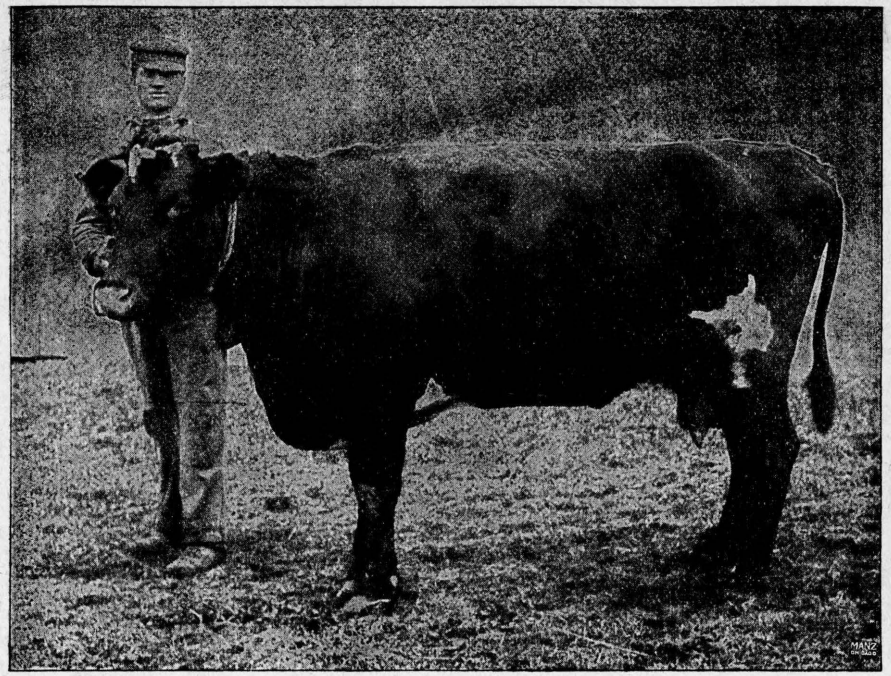
	Temperature after injection.									Quantity injected.
	6 a.m.	8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	
1897, June 16.	101.	101.6	101.3	103.8	**104.8**	102.2	**104.**	**104.**	.....	2.0 c. c.
Sept. 8.	101.8	102.8	**104.**	**105.6**	**105.8**	**105.8**	**105.**	**105.2**	**104.**	2.0 c. c.
Dec. 29.	101.6	102.8	**105.**	**105.8**	**106.**	102.	103.8	103.6	103.	2.0 c. c.
1898, May 24.	101.2	101.6	103.	**104.4**	**105.2**	**105.2**	**104.2**	**104.4**	**104.**	2.0 c. c.
July 1.	.....	101.6	101.2	101.8	101.8	101.8	102.8	103.4	103.4	2.0 c. c.
Aug. 30.	101.2	101.	101.6	102.4	102.8	**105.**	.....	103.	.....	2.0 c. c.
Oct. 4.	.....	101.6	101.6	101.6	101.4	102.	102.	**104.2**	103.	2.0 c. c.
Nov. 1.	.....	101.6	103.4	102.2	102.8	103.4	**104.4**	103.6	103.8	2.0 c. c.
Dec. 3.	.....	101.4	102.2	102.6	102.4	101.8	102.2	103.6	102.2	2.0 c. c.
1899, Jan. 3.	.....	101.8	102.2	102.6	102.6	102.6	103.	102.8	102.4	2.5 c. c.
Feb. 3.	.....	101.4	101.8	102.4	102.	101.6	102.	102.	101.4	3.0 c. c.
Mch. 3.	.....	101.4	102.	101.8	102.2	103.2	103.4	102.4	102.2	3.0 c. c.
Mch. 29.	.....	102.	102.	102.	102.8	102.2	102.4	102.8	102.4	3.0 c. c.

* Calves were dropped Oct. 19, 1897, and Nov. 21, 1898.

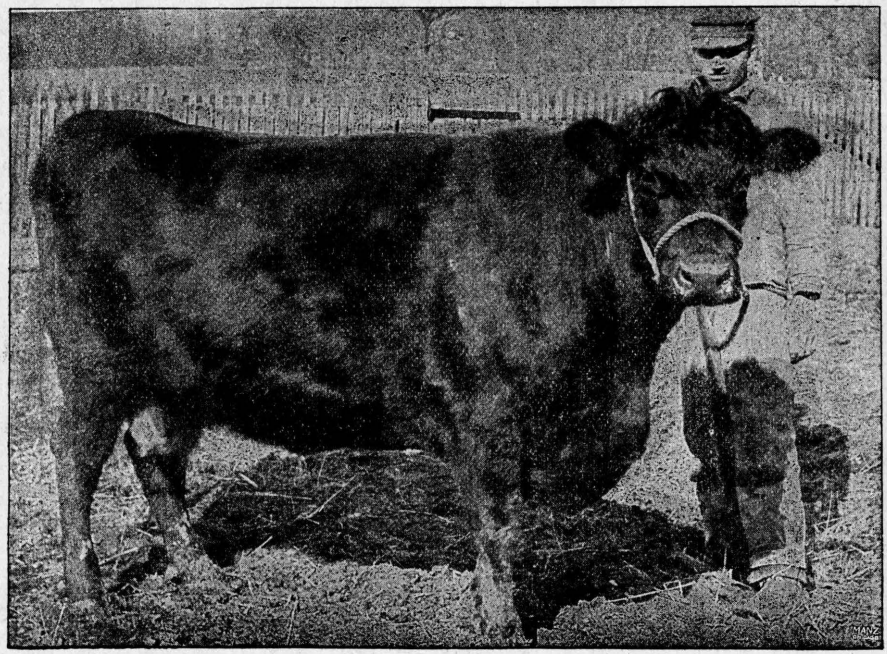
In the case of No. 28 there was a well marked reaction at each of the four tests made during the first year, followed by an afternoon rise in temperature of one to two degrees, both before and after the test, at the next three tests. For the last five months, however, the records show but little variation in temperature, except a slight rise following the test on January 3 and March 3, notwithstanding the increase in the dose of tuberculin.

On autopsy tubercles were found in the retro-pharyngeal, mesenteric, bronchial and post-mediastinal glands (encapsuled in the bronchial glands) in the lower lobe of each lung and on both pleural surfaces. An abscess was found under the diaphragmatic peritoneum.

The cow had been in good condition and was increasing in weight, as shown by the table.



LADY TEHL



VANITY LASS

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TABLE VII—No. 29—PATTI: Red Polled cow, 7 years old at first test.

Date.	Live weight.	Temperature bofore injection.								
		8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	Average.
1897, June 15.	.....	.....	101.	101.2	101.8	101.4	101.6	102.2	102.4	101.7
Sept. 7.	.....	100.	100.	100.8	101.2	101.4	102.2	101.8	102.2	101.2
1898, Jan. 10.	1103	101.8	102.	100.8	102.	101.8	102.	101.4	101.2	101.6
May 23.	1096	101.2	101.6	101.6	102.	102.	101.2	101.2	101.8	101.8
June 30.	1146	101.6	101.8	102.	101.8	101.8	102.2	102.8	102.4	102.
Aug. 29.	.....	101.6	101.2	101.6	102.	102.6	102.4	103.	.....	102.1
Oct. 3.	1180	101.4	101.6	101.8	101.6	102.4	102.8	103.4	103.	102.2
Oct. 21.	1205	101.	102.	102.	101.6	102.2	102.	101.6	101.6	101.7
Dec. 2.	1224	102.2	102.6	101.8	102.	101.6	102.8	102.4	102.4	102.2
1899, Jan. 2.	1288	101.	101.6	102.	101.4	101.8	102.2	101.6	101.2	101.6
Feb. 2.	1275	102.	102.	102.4	102.4	101.6	102.4	102.	101.	102.
Mch. 28.	1021	101.6	101.6	101.2	101.4	102.	102.2	102.	101.8	101.7

	Temperature after injection.									Quantity injected.
	6 a.m.	8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	
1897, June 16.	101.4	99.8	101.2	103.6	**105.8**	**105.8**	**105.**	**106.**	.....	2.0 c. c.
Sept. 8.	102.	101.8	103.	**105.**	**105.**	**104.4**	**104.**	**104.2**	**104.**	2.0 c. c.
1898, Jan. 11.	101.6	101.6	102.2	102.4	**104.**	**104.**	103.6	102.8	102.8	2.0 c. c.
May 24.	101.2	101.2	101.6	102.2	102.6	102.4	102.6	102.4	102.6	2.0 c. c.
July 1.	.....	101.2	101.4	101.8	102.	102.4	103.8	**104.6**	103.2	2.0 c. c.
Aug. 30.	100.8	101	101.6	101.8	101.8	102.	.....	103.	.....	2.0 c. c.
Oct. 4.	.....	101.2	101.4	101.4	101.8	102.	103.	103.	102.8	2.0 c. c.
Nov. 1.	.....	100.6	101.8	101.	101.4	102.	102.6	102.4	102.	2.0 c. c.
Dec. 3.	.....	102.	102.8	102.6	102.8	101.6	103.	103.	102.8	2.0 c. c.
1899, Jan. 3.	.....	101.4	102.4	101.6	102.3	102.	103.4	103.	103.2	2.5 c. c.
Feb. 3.	.....	102.	102.2	103.	103.2	103.	104.	103.2	103.2	3.0 c. c.
Mch. 29.	.....	102.	102.	101.4	101.6	101.6	102.2	102.	101.8	3.0 c. c.

No. 29 had shown well marked reactions to the first three tuberculin tests. The fourth test was passed without reaction, and at the fifth, sixth and seventh tests there were indications of afternoon fever before, as well as following the injection; the eighth test was passed without change of temperature; at the ninth, tenth and eleventh tests there was a slight rise following the injection, but the twelfth test was passed without change. A calf was dropped between the eleventh and twelfth tests.

On autopsy tubercles were found in the portal and bronchial glands; several tubercles in each lung, and an abscess the size ot a hen's egg in the liver.

TABLE VIII—No. 30—VANITY LASS: Polled Angus cow, 8 years old at first test.

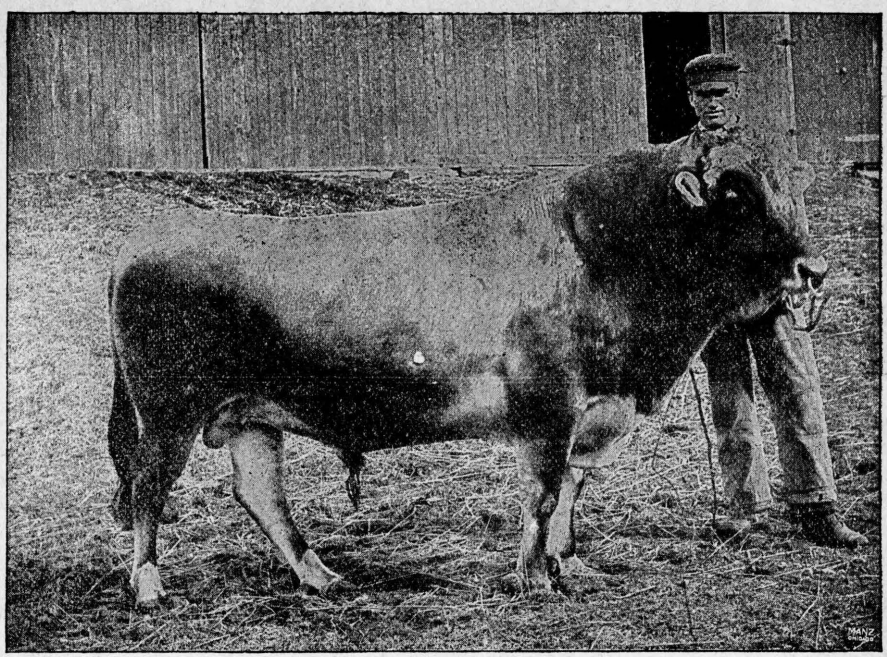
Date.	Live weight.	Temperature before injection.								
		8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	Average.
1897, June 15.	.....	.....	100.2	101.2	101.	101.8	101.8	101.6	101.6	101 3
Sept. 7.	.....	101.	100.6	101..	101.2	101.4	101.4	101.4	101.2	101.1
Dec. 28.	1100	102.	100.8	101.8	101.	.....	102.	100.6	101.2	101.3
1898, May 23.	1321	101.8	101.4	101.6	102.	101.8	102.	102.	101.6	101.8
June 30.	1365	101.6	101.6	101.6	101.6	101.4	102.2	102.6	102.4	101.9
Aug. 29	.. ..	101.4	101.2	101.6	101.	101.4	102.6	103.	.....	101.7
Oct. 3.	*1227	101.	101.6	101.2	101.2	102.	**103.**	**104.**	**103.**	102.1
Oct. 31.	1226	102.	101.8	101.2	102.	102.2	101.8	101.6	101.8	101.8
Dec. 2.	1281	103.8	103.6	102.6	101.8	101.6	101.2	100.8	100.4	102.
1899, Jan. 2.	1257	101.4	101.4	101.	101.8	101.6	101.6	100.8	101.	101.3
Feb. 2	1298	100.6	101.4	101.	101.4	101.	100.6	100.6	101 8	101.
Mch. 2.	1344	100.4	101.4	101.6	101.8	102.	102.	101.6	101.4	101.5
Mch. 28.	1336	101.4	101.6	101.	101.8	101.8	102.	101.2	101.4	101.5

	Temperature after injection.									Quantity injected.
	6 a.m.	8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	
1897, June 16.	102.4	**104.8**	**106.**	**105.6**	**104.**	**104.**	**104.**	**104.**	.....	2.0 c. c.
Sept. 8.	**105.6**	**105.2**	**105.**	**105.4**	**105.**	**104.**	103.8	103.	102.6	2.0 c. c.
Dec. 29.	101.6	102.8	**105.8**	**107.**	**104.8**	**102.6**	**104.6**	103.6	102.6	2.0 c. c.
1898, May 24.	101.2	101.6	102.	**105.**	**105.4**	**104.8**	**103.8**	**104.8**	103.6	2.0 c. c.
July 1.	.... .	102.8	102.4	101.8	102.8	**104.2**	**104.4**	**104.2**	**104.4**	2.0 c. c.
Aug. 30.	101.4	100.8	101.4	101.4	102.2	102.8	....	103.4	.....	2.0 c. c.
Oct. 4.	.....	101.4	101.4	101.2	101.8	102.	102.2	103.	103.4	2.0 c. c.
Nov. 1.	.....	103.8	103.6	**104.**	102.6	102.	102.	102.	101.8	2.0 c. c.
Dec. 3.	.....	102.	101.8	102.2	101.4	103.2	**104.**	103.2	102.8	2.0 c. c.
1899, Jan. 3.	.. ..	101.2	102.	102.	102.4	102.	103.	103.4	103.6	2.5 c. c.
Feb. 3.	....	101.	101.2	101.4	102.4	**104.**	**105.**	**104.**	101.	3.0 c. c.
Mch. 3.	.....	102.	101.2	101.	101.4	101.8	101.8	101.8	101.8	3.0 c. c.
Mch. 28.	.....	101.4	101.4	101.4	102.2	101.6	102.	101.4	101.	3.0 c. c.

* A calf was dropped Sept. 15, 1898.

In the case of No. 30 there were distinct reactions to the first five tests, followed by increase of temperature of afternoons, both before and after testing, for several months, then after testing only for several months longer. The last two tests were passed without change of temperature. The cow had increased steadily in weight up to the first of March, and was very fat when killed.

The autopsy revealed tubercles in the retro-pharyngeal, mesenteric and portal glands and several abscesses in the liver. One hind quarter of the udder was diseased.



TEENY'S FIRST

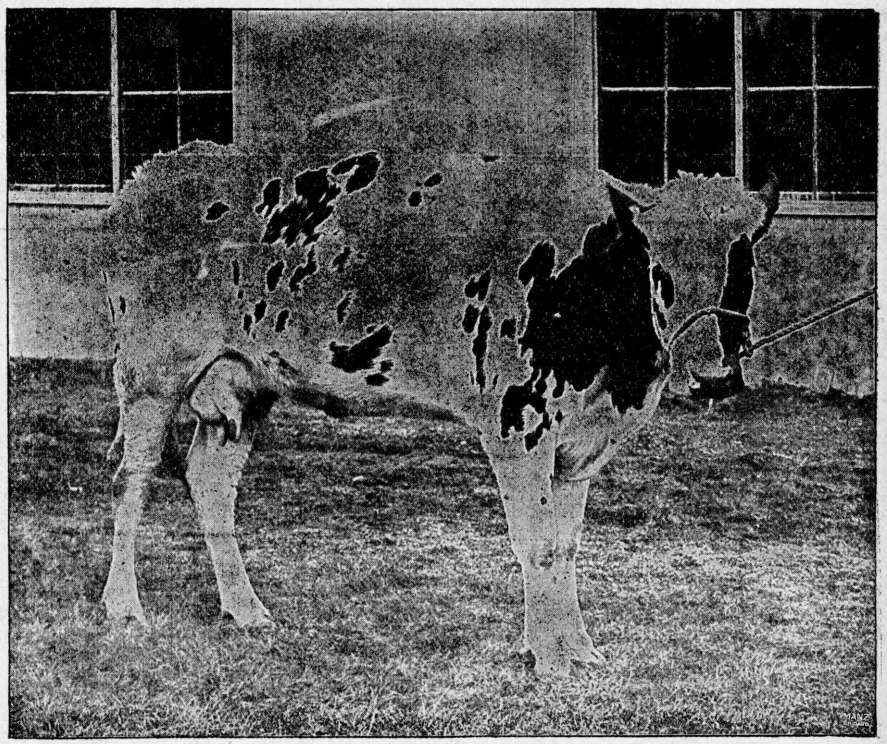


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TABLE IX—No. 31—TEENY'S FIRST: Jersey bull, nearly 8 years old at first test.

Date.	Live weight.	Temperature before injection.								
		8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	Average.
1897, June 17.	.....	.....	.....	.....	101.	101.6	101.8	101.8	101.6	101.6
Sept. 7.	.....	100.	100.8	101.	101.	101.2	101.8	99.2	100.8	100.7
1898, June 30.	.....	101.8	102.2	102.	101.8	102.2	102.6	102.4	102.	102.1
Aug. 29.	.....	101.2	101.4	101.4	101.6	102.	**103.2**	**103.**	.....	102.
Oct. 3.	.....	101.	101.8	101.6	101.8	102.	102.	**104.8**	102.8	102.2
Oct. 31.	.....	101.	100.8	101.	101.4	101.8	101.6	100.4	101.2	101.1
Dec. 2.	.....	100.	100.8	101.4	101.6	101.6	101.6	99.8	100.	100.8
1899, Jan. 2.	1470	.....	101.	101.	101.6	101.2	101.6	101.	100.6	101.1
Feb. 2.	1499	99.2	101.6	101.8	101.4	101.	101.8	100.6	100.4	101.
Mch. 2.	1535	100.6	100.6	100.8	101.	102.4	101.8	101.6	101.2	101.2
Mch. 28.	1581	101.	101.	101.2	100.4	101.	101.8	101.4	101.	101.1

	Temperature after injection.									Quantity injected.
	6 a.m.	8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	
1897, June 18.	101.8	102.2	102.2	**106.**	**106.6**	**106.6**	**103.**	**104.8**	.....	.....
Sept. 8.	102.2	103.4	**104.4**	**106.**	**106.**	**106.**	**104.6**	103.	103.	.....
1898, July 1.	.....	102.2	102.2	**105.**	**104.2**	**104.6**	**104.**	103.4	102.2	.....
Aug. 30.	101.4	100.4	102.2	102.2	102.4	102.8	.....	103.	.....	.....
Oct. 4.	.....	102.	102.4	103.	102.2	102.2	102.2	102.	102.4	.....
Nov. 1.	.....	100.6	101.	101.	101.	101.6	100.6	100.4	100.8	.....
Dec. 3.	.....	100.8	100.8	100.8	101.4	100.2	101.2	101.2	101.	.....
1899, Jan. 3.	.....	101.2	101.	101.4	101.4	101.4	101.6	101.	101.	3.0 c. c.
Feb. 3.	.....	101.	101.4	101.4	101.6	101.6	102.2	101.4	101.2	3.0 c. c.
Mch. 3.	.....	101.2	100.4	101.	101.	101.4	102.	101.4	101.	3.0 c. c.
Mch. 29.	.....	100.8	100.6	101.2	100.6	100.8	100.4	100.8	101.	3.0 c. c.

The bull, No. 31, gave well marked reactions to the first three tests, with somewhat high temperatures at the next two, but for five months there had been no sign of abnormal temperature, and he was steadily increasing in weight. When killed he was very fat, his hair was sleek and bright, and he showed every external sign of perfect health.

On autopsy both retro-pharyngeal glands were found tubercular; the mesenteric glands were hard and congested; the portal glands were indurated, but without caseation or pus, and there was an old, encapsuled abscess in the liver.

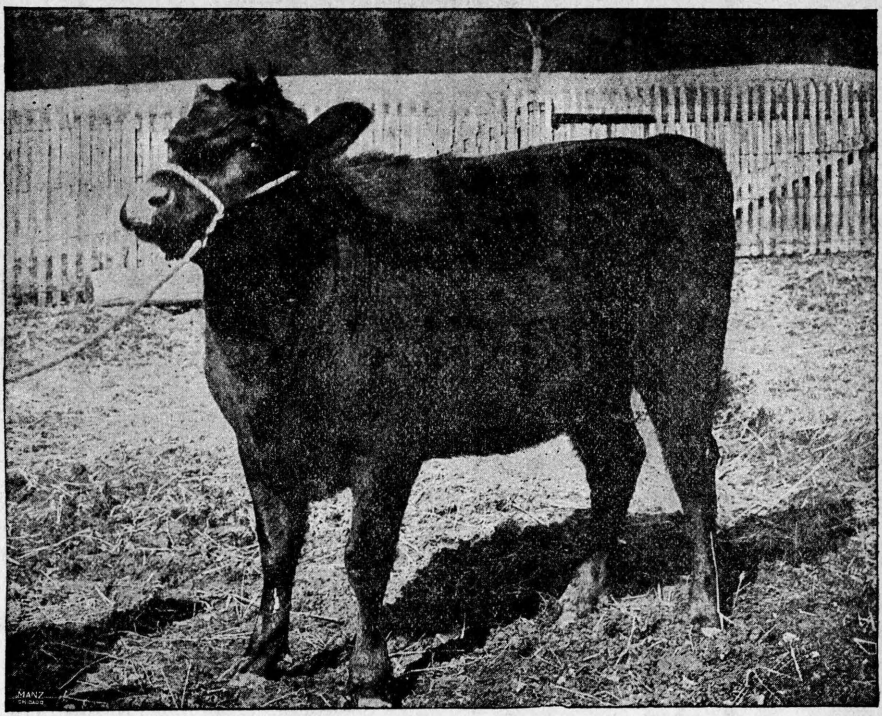
TABLE X—No. 32—VANITY'S THIRD: Polled Angus heifer, 14 months old at first test.

Date.	Live weight.	Temperature before injection.								
		8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	Average.
1898, Jan. 10.	.....	102.	102.4	102.	102.2	101.8	102.	102.	102.	102.
June 30.	.....	102.	102.	101.8	102.	102.6	**103.8**	**103.**	102.2	102.4
Aug. 29.	.....	102.	101.8	102.	102.4	102.6	102.8	**103.2**	.....	102.4
Oct. 3.	.....	101.4	101.2	102.6	102.	102.	102.6	**103.6**	**103.4**	102.3
Oct. 21.	.....	101.4	101.	101.2	103.	102.	**103.**	101.8	102.	101.9
Dec. 2.	.....	102.	102.	102.	102.	101.6	101·6	101.6	101.	101.7
1899, Jan. 2.	782	101.2	101.6	101.6	102.	102.	102.	102.	101.8	101.8
Feb. 2.	812	101.4	101.6	101.8	101.8	100.4	101.2	101.4	101.4	101.4
Mch. 2.	833	101.4	101.6	101.8	101.2	102.	102.	101.6	101.2	101.6
Mch. 28.	857	101.8	101.6	101.8	101.6	101.8	102.	101.8	101.6	101.7

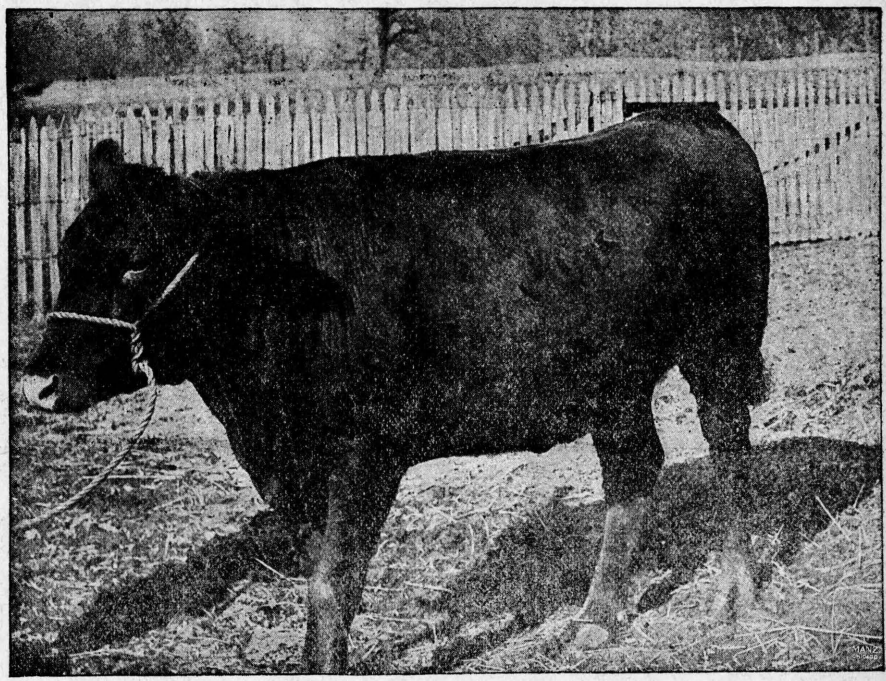
	Temperature after injection.									Quantity injected.
	6 a.m.	8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	
1898, Jan, 11.	102.4	102.8	103.	103.6	103.6	103.6	103.	102.4	102.2	.....
July 1.	.....	102.2	102.2	101.8	102.2	103.	**104.**	**104.**	103.	.....
Aug. 30.	102.4	102.4	102.2	102.	102.	103.4	.....	102.8	.....	.....
Oct. 4.	.....	101.8	101.6	101.6	101.8	102.	103.	103.	103.2	.....
Nov. 1.	.....	101.4	101.4	101.2	101.4	101.4	102.	102.4	102.4	.....
Dec. 3.	.....	102.2	101.8	101.6	102.	102.	102.	101.6	101.4	.....
1899, Jan. 3.	.....	102.2	102.	102.2	102.2	102.	102.6	103.	102 6	2.0 c. c.
Feb. 3.	.....	102.	102.	102.2	102.2	102.8	102.	102.2	102.	2.0 c. c.
Mch. 3.	.....	101.	101.	102.	102.	101.8	102.4	102.	102.	2.0 c. c.
Mch. 29.	.....	102.	102.	101.	101.4	102.	102.	101.8	101.6	2.8 c. c.

No. 32, a daughter of Vanity Lass, had shown abnormal afternoon temperatures on several occasions, but never a well marked, tuberculin reaction.

The mesenteric glands were enlarged and indurated, but no other abnormal condition was observed. The animal was in good flesh and apparently in perfect health. She was condemned chiefly on the test of July 1, 1898, but it would seem that in handling young animals a larger margin should be allowed than was done in this case.



VANITY'S THIRD



NELLY'S THIRD

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TABLE XI — No. 33 — NELLY'S THIRD: Red Polled heifer, 2 years old at first test.

Date.	Live weight.	Temperature before injection.								
		8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	Average.
1898, Sept. 9.	.....	101.2	101.2	101.6	101.8	101.8	102.	102.6	102.6	101.8
Oct. 31.	.....	100.6	102.	102.	102.	101.4	102.	102.2	101.6	101.7
Dec. 2.	.....	101.8	102.	101.4	101.6	101.2	101.2	101.4	102.6	101.6
1899, Jan. 2.	907	101.8	.....	101.6	101.6	101.6	102.2	101.2	101.4	101.6
Feb. 2.	951	101.6	101.6	101.6	101.4	101.6	102.	101.4	101.	101.5
Mch. 2.	985	101.8	102.	102.	102.	101.6	101.8	101.6	101.6	101.8
Mch. 28.	1003	100.8	101.6	101.2	101.	101.8	102.2	101.6	101.2	101.4

	Temperature after injection.									Quantity injected.
	6 a.m.	8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	
1898, Sept. 10.	.....	**105.**	**105.6**	**106.**	**106.8**	**106.8**	.....	.....	.....	.....
Nov. 1.	.....	102.8	**104.4**	**105.**	**105.**	**104.4**	**105.**	**104.**	103.8	.....
Dec. 3.	.....	103.	103.6	103.6	103.8	103.4	**104.**	103.	103.	.....
1899, Jan. 3.	.....	101.4	102.4	102.	102.	102.2	102.4	102	102.	2.0 c. c.
Feb. 3.	.....	101.8	101.8	102.	102.	102.4	102.6	102.	101.8	2.0 c. c.
Mch. 2.	.....	101.8	102.	102.	101.8	101.8	102.6	102.	101.8	2.0 c. c.
Mch. 29.	.....	101.	101.4	101.	101.	100.6	101.	101.2	101.	2.0 c. c.

No. 33 had given two well marked reactions to the tuberculin test, with a third, somewhat indecisive, followed by four negative tests.

Tubercles were found in the retro-pharyngeal glands. The heifer was in splendid condition, and by external appearances in perfect health when killed.

TABLE XII — No. 34 — GRACE MAHOMET: Holstein heifer, 1 year old at first test.

Date.	Live weight.	Temperature before injection.								
		8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	Average.
1898, Sept. 12.	....	102.	101.8	101.6	102.	102.	102.4	**103.**	**103.6**	102.3
1899, Jan. 2.	455	102.4	102.8	102.7	103.8	101.6	**103.**	102.4	**103.6**	102.8
Mch. 2.	603	102.	102.6	102.	102.	102.8	102.4	102.6	102.	102.3
Mch. 28.	669	102.6	102.	101.8	101.	101.2	102.2	101.8	102.2	101.8

	Temperature after injection.									Quantity injected.
	6 a.m.	7 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	
1898, Sept. 13.	.....	101.6	101.6	102.6	102.4	103.	**104.4**	**105 2**	**105.2**	.....
1899, Jan. 3.	.....	102.4	103.	103.2	103.2	102.	103.6	103.8	103.6	1.2 c. c.
Mch. 3.	.....	102.	101.8	101.6	101.8	102.	103.2	101.4	101.2	1.5 c. c.
Mch. 29.	.....	102.	102.8	101.	101.6	101.8	102.8	100.8	101.8	1.8 c. c.

No. 34 had shown a distinct reaction in September, 1898, with abnormal temperatures before and after the test of January following, but had passed two later tests without reaction.

The portal glands were found enlarged and indurated, but without caseation or pus. On the small intestines there were found great numbers of small, pea-sized, caseated foci, containing green-colored, caseous masses, probably of parasitic origin. There had been some diarrhœa, but the animal was still in good condition.

TABLE XIII—No. 35—VIOLA'S FOURTH: Red Polled heifer, 17 months old at first test.

Date.	Live weight.	Temperature before injection.								
		8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	Average.
1898, Sept. 9.	. . .	102.4	101.4	102.	102.6	**103.**	**103.4**	**103.**	**103.4**	102.6
1899, Jan. 2.	694	101.6	101.6	101.6	102.2	102.4	101.8	101.2	101..	101.7
Mch. 2.	802	101.4	101.8	101.8	101.6	102.6	102.4	102.	101.4	101.9
Mch. 28.	823	102.	101.8	101.4	101.2	102.	101.8	101.4	101.	101.6
		Temperature after injection.								Quantity injected.
	6 a.m.	8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	
1898, Sept. 10.	.....	102.2	102.	102.	102.4	102.6	**104.**	**104.4**	.....	.....
1899, Jan. 3.	. ...	101.6	101.6	102.	102.4	101.8	101.8	102.	102.2	1.5 c. c.
Mch. 3.	.....	101.4	101.4	100.8	101.	101.8	101.8	101.6	101.8	1.5 c. c.
Mch. 29.	.....	101.4	101.8	101.4	101.6	100.8	101.6	101.6	101.6	1.5 c. c.

No. 35 was condemned because of the rise of temperature at the first test. It will be observed that the temperature was slightly above the normal on the afternoon preceding the test, and that the total elevation, following the injection of tuberculin, was less than two degrees above the average temperature of the previous day.

The autopsy revealed no indication of tubercular disease, but the intestines were slightly infested with the nodules found on several of the younger cattle killed in this test

TABLE XIV—No. 36—FANNY DAW'S SECOND: Holstein cow, 2 years old at first test.

Date.	Live weight.	Temperature before injection.								
		8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	Average.
1897, Dec. 22.	....	102.	102.	102.	102	101.6	101.	101.6	101.2	101.7
1898, Sept. 9.	.....	102.2	101.6	102.4	101.8	**104.**	**103.**	**103.2**	**103.4**	102.7
1899, Jan. 2.	1042	101.4	101.4	102.2	101.8	100.	101.	101.2	101.8	101.3
Mch. 2.	946	101.2	102.	103.	102.4	**103.2**	101.6	101.4	101.6	102.
Mch. 28.	980	100.8	101.8	101.2	101.8	102.	102.2	101.8	102.	101.7

	Temperature after injection.									Quantity injected.
	6 a.m.	8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	
1897, Dec. 23.	101.8	101.4	102.4	101.8	101.8	100.8	101.	100.8	101.6	.....
1898, Sept. 10.	.....	102.4	102.4	102.	104.	103.	**104.**	103.	.....	.....
1899, Jan. 3.	.....	102.2	102.2	102.4	103.	103.2	102.2	102.	102.	2.0 c. c.
Mch. 3.	.....	101.6	101.6	101.	102.	102.2	102.6	102.	102.2	2.0 c. c.
Mch. 29.	.....	102.8	102.4	101.6	102.4	102.4	102.	101.8	102.	2.0 c. c.

In the case of No. 36, as in that of No. 35, there had been a suspicious rise of temperature in the September test, following a slight rise the previous afternoon, the total elevation reaching only to 104 degrees.

On autopsy the same conditions were found as in the case of Viola's Fourth — an entire absence of tubercular deposits, but a few nodules on the intestines.

TABLE XV—No. 37—INFIRMARY CALF: Grade Red Polled heifer, 2 weeks old at first test.

Date.	Live weight.	Temperatnre before injection.								
		8 a.m,	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	Average.
1898, Sept. 9.	.....	102.6	102.	102.	102.2	102.	102.4	102.	101.8	102.1
Oct. 31.	.....	101.4	102.4	102.	103.	103.	103.	104.	103.6	102.8
1899, Jan. 2.	357	102.4	102.8	102.8	103.	103.	103.	102.6	103.	102.8
Mch. 28.	516	101.8	101.8	102.	102.	102.2	102.6	101.8	102.2	102.

	Temperature after injection.									Quantity injected.
	6 a.m.	8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	
1898, Sept. 10.	.....	102.4	102.2	102.6	102.8	102.6	102.6	103.	.....	.....
Nov. 1.	.....	100.2	102.	102.2	101.8	102.8	102.4	102.4	102.6	.....
1899, Jan. 3.	.....	102.6	102.6	102.8	102.6	103.6	103.4	103.	103.	1.2 c. c.
Mch. 29.	.....	102.6	101.8	102.4	102.	102.	102.	102.	102.	1.4 c. c.

No. 37 had been purchased for the purpose of feeding it the milk of the tuberculous cows included in this test. It was not related to any of the cattle in the Station herd. The tuberculin record shows no reaction at any time to the test, and the autopsy revealed no indication of any disease whatever. It will be observed that the calf was only two weeks old at the September test, and that it was not infested with the intestinal nodules found in the older animals.

TABLE XVI — No. 38 — PETER DAW: Holstein bull, 3 months old at first test.

Date.	Live weight.	Temperature before injection.								
		8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	Average.
1898, Sept. 12.	322	102.2	101.4	101.2	102.4	102.6	103.4	102.6	102.8	102.3
1899, Jan. 2.	.....	102.2	102.6	102.6	103.4	101.6	102.4	102.	102.	102.3
Mch. 28.	533	103.6	103.2	101.6	102.	102	102.	102.8	102.	102.4

	Temperature after injection.									Quantity injected.
	6 a.m.	8 a.m.	10a.m.	12 m.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10p.m.	
1898, Sept. 13.	.....	102.	102.6	103.4	**105.**	104.	103.8	104.	102.6	.....
1899, Jan. 3.	.....	**105.4**	**106.4**	**106.6**	**107.**	**107.**	**106.2**	**106.**	**105.6**	1.2 c. c.
Mch. 29.	.....	104.	104.	102.8	102.8	103.	103.6	103.8	103.8	1.5 c. c.

Peter Daw had given two distinct reactions to the tuberculin test, and the autopsy showed enlarged and indurated mesenteric glands, with several small nodules in the intestines, filled with greenish, caseous matter, such as were observed in several of the younger animals.

As pertinent to the afternoon fever, previous to the tuberculin injection, which has been observed in several of the cattle included in this test, I give the following averages of 100 observations, made on 38 non-reacting cattle, of all ages, between June, 1897, and April, 1899, the cattle being taken without other selection than their failure to react to the tuberculin test.

8 A. M.	10 A. M.	12 M.	2 P. M.	4 P. M.	6 P. M.	8 P. M.	10 P. M.
102.07	102.06	101.92	102.01	101.89	102.01	101.95	101.75

It will be observed that these average temperatures show no indication of afternoon elevation. The occurrence, however, of high temperatures in some of our animals which were found to be only in the first stages of tuberculosis, or entirely free from tubercular deposits, shows that such temperatures cannot always be taken as indicating advanced consumption.

The nodular deposits on the intestines, found in several of these younger cattle, are not unusual. When their contents are greenish in color, as in these cases, parasitism is indicated, tubercular deposits being yellowish.

The tuberculin records and post mortem notes of the 12 animals slaughtered in the test of April 11 (No.'s 27 to 38, inclusive) were submitted to Dr. D. E. Salmon, Chief of the Bureau of Animal Industry, who directed that the carcasses of No.'s 28, 29, 30 and 31 should be destroyed, and authorized the sale for food of the remainder. On four of these last, it will be observed, no indication of tubercular disease had been found, and on the other four the lesions were limited to the enlargement or induration of a single gland, or set of glands, without caseation or pus.

CONCLUSIONS.

In the 38 cases herein reported there have been but two, No's 15 and 27, in which the tuberculin diagnosis, whether positive or negative, has not been confirmed by post mortem examination. In the case of No. 15 there was ample time for infection between the test and the autopsy, and in that of No. 27 there is the possibility that recovery had taken place.

In a number of cases, however, especially in those in which the test was most frequently repeated, animals after responding to the test have ceased to react to later tests, and yet have been found tuberculous when killed. In some of these cases there has been room to believe that the disease was in abeyance, or even that a recovery had been made, or was in progress; but it would not be safe to assume that the non-reaction to the test of an animal which has previously given one or more distinct reactions is, in itself, evidence of recovery.

EFFECT OF THE TUBERCULIN TEST ON THE HEALTH OF THE ANIMAL.

It is, of course, impossible to tell the exact condition of these cattle when they were first injected with tuberculin; but at the time when the draft was made for the slaughter of June 8, 1898, the seven animals which were reserved were, as well as we could determine, as far advanced with the disease as the reacting animals which were killed. Six of these reserves had reacted to the tuberculin test as distinctly and as often as those which were killed, and they were in no better condition, as judged by visual inspection, all being apparently in perfect health.

One of these reserves soon died with advanced tuberculosis, but the autopsies on those which were killed ten months later indicate, if any difference, a less advanced, rather than a farther advanced stage of the disease than that found in those killed at the earlier date, while in the case of the younger animals, added to this reserve herd as the result of later tests, the disease had not progressed in six months beyond the enlargement and induration of one or two glands, and all this in the face of tuberculin injections, repeated every four to six weeks.

The bull, No. 31, which had first reacted nearly two years previous to the autopsy, had passed the last six tests with no elevation of temperature whatever, and the lesions found were limited to a few glands and an old, partly healed abscess in the liver. In the case of the older cows the later tests were usually followed by slight elevations of temperature, although not sufficient to be taken as indicating tubercular disease had they not been preceded by more decided reactions. While the disease showed evidences of generalization in these cases, there was no sign of rapid progress, and, taken as a whole, the tests cannot be interpreted as supporting the theory that the tuberculin test will arouse dormant cases of tuberculosis and start the disease into a more active form.

On the other hand, these experiments show that the tuberculin test indicates the presence of tuberculosis at such an early stage as to give ample time to fatten the animal before the disease has progressed so far as to affect the meat.

DISPOSAL OF THE MEAT OF TUBERCULOUS ANIMALS.

The question whether the carcasses of the animals slaughtered in the incipient stages of tuberculosis should be used for food is one of far reaching importance. If this disease were attended from the first with high fever and other symptoms of general sickness, there could be no question on this point; but the fact is that, in its ordinary course, there is no fever and not the slightest sign of functional derangement until either the liver or the lungs, usually both, have become deeply involved, and this, as shown by the tests herein reported, may not occur for two years or more after the first infection.

During this period the disease is limited to organs which are not ordinarily used for food, and if the portions of the carcass which are so used were accidentally infected by the knife of the butcher such infection would be limited to the outside of the meat, where the germs would most surely be destroyed by cooking, while those who eat raw meat take far greater risks than that from tuberculosis.

In view of these facts the governments of Germany, France and Denmark and our own Bureau of Animal Industry authorize the sale for food of carcasses of animals in which tuberculosis, though present, has not become generalized, the only exception to the unobstructed sale of such meat being in the case of Germany, where it is required that it must be first boiled and then sold as coming from tuberculous cattle.

Our experiments have shown that an animal may be capable of several years of usefulness after it has become infected with tuberculosis, but that it is liable at any time to break down; while we do not know when it may first become a disseminator of the seeds of the disease; possibly from the first infection, more likely, in most cases, not until after the disease has become more generalized.

Under these circumstances the average cattle owner will be much more reluctant to consent to the slaughter of young cattle because of reaction to the tuberculin test if all which show the infection are to be destroyed, no matter how slight the lesions, than if such as are in perfect health, except the incipient infection of one or two minor glands, may be sold for meat. Under the first named conditions there will be the constant temptation to try to keep the animal a little longer, in the hope that it may recover, or that a little more produce may be realized from it, or else to smuggle it into the market, than if it can be sold openly for food, subject only to the conditions of an inspection which certainly

seems to conform to all reasonable hygienic requirements without unnecessary sacrifice of property.

HOW FREQUENTLY SHOULD THE TUBERCULIN TEST BE REPEATED.

Our tests show that the tuberculin test may be repeated as often as once a month, not only without injury to the animal but with a suggestion of curative effect; but when the object is to ascertain whether tuberculosis is present the interval between injections should be longer than a month. Considering all points it would seem that once in six months would be sufficiently often for the testing of a herd from which the disease is being extirpated, and that once a year would be often enough for an ordinary dairy or breeding herd in which no tuberculosis has appeared.

Experiments touching on the curative effect of tuberculin are reported in the annual reports of the Pennsylvania State College Experiment Station for 1894 (p. 110); of the New Jersey Agricultural College Experiment Station for 1895 (p. 187), and 1897 (p. 224); of the Canada Experimental Farms for 1896 (p. 89); of the Delaware College Agricultural Experiment Station for 1898 (p. 14); of the Maine Agricultural Experiment Station for 1897, and in Bulletin 29 of the Iowa Agricultural College Experiment Station, but none of these can be considered decisive.

It is well established that the reactions become less and less distinct in frequent repetitions of the tuberculin test, a fact that opens the way for serious abuse of this test.

It should be stated that the animals included in our last slaughter test had been fed for fattening for several months before the slaughter, a fact which may have had some influence in retarding the progress of the disease.

TUBERCULOSIS IN SWINE.

Out of a litter of seven Berkshire pigs four were selected in the fall of 1898, separated into two lots of two pigs each and fed on the milk of the cows of the reserve herd; the milk being pasteurized for one lot, but fed untreated to the other. Other food was added and the pigs grew well and fattened. As they came from a sow that had been on the farm several years and had produced several litters of apparently healthy pigs, they were not tested with tuberculin at the beginning of this experiment; but a few days before the slaughter test of April 11 they were subjected to the test and all gave the characteristic reaction. When slaughtered, all were found to be in a condition of generalized tuberculosis; tubercular deposits being found along the windpipe, in the bronchial, mesenteric and portal glands and in the liver. One of the livers is shown on page 325. Later, the other three pigs, which had no milk, were killed, and these were found to be in practically the same condition as those which had been

under experiment. To external appearance the pigs were all in perfect health.

A few days after the slaughter the sow died in pig-bed. She was carefully examined, and while a very few, small, tubercular deposits were found in the liver, there was nothing that could account for the condition of the pigs until the udder was opened; but in that was a solid, calcified mass of tubercle, nearly as large as a hen's egg. This mass was covered with a fleshy envelope, and was apparently in a dormant condition, there being no pus. Apparently the sow had been sowing the seeds of infection in her progeny while suffering but little inconvenience from the disease herself.

The investigations of the Bureau of Animal Industry indicate that swine are quite as subject to tuberculosis as cattle, and that the meat of tuberculous swine is even more dangerous than that of tuberculous cattle, because the disease, as a rule, becomes generalized more rapidly in swine than in cattle. As an illustration, the disease was farther advanced in the case of the one-year-old pigs above referred to than in that of cattle which had reacted to the tuberuclin test nearly two years before.

THE PREVALENCE OF BOVINE TUBERCULOSIS.

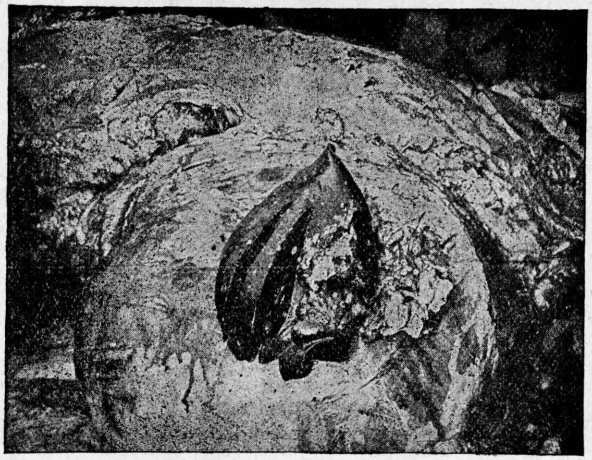
Before the discovery of the tuberculin test it was impossible to make even an approximate estimate of the proportion of cattle affected with tuberculosis; but the work which has been done since that discovery shows that the disease is far more prevalent than had been suspected.

The most thoroughgoing investigations on this point which have been carried out in any country are those made in Denmark, under direction of Dr. B. Bang, of Copenhagen. Up to the end of October, 1895, Dr. Bang had reported the testing with tuberculin of 53,200 cattle in 1,972 herds, by 210 Veterinarians. Of this number, 26,665. or 38.7 percent reacted to the test. In 107 of these herds, containing more than 50 cattle each, the percentage of reacting animals was 59.8; while in herds of less than 50 cattle it was 32.2 percent. 309 herds, containing less than 50 each, were found free from the disease. In other words, 5 herds out of every 6 were infected, and in infected herds 2 animals out of 5, in the average, were diseased.[1]

In 1897 the British Royal Commission on Tuberculosis visited Denmark and found that up to that time nearly 150,000 cattle had been tested under Dr. Bang's direction, with results that were considered very satisfactory by the owners and the authorities. This same Commission visited Belgium, and found that 22,000 cattle had been tested, and Prof. J. McFadyean, in a summary of the report of the Royal Commission[2] estimates

[1] Report in Bulletin 41, Massachusetts (Hatch) Experiment Station.

[2] Journal of the Royal Agricultural Society of England, June, 1898, pp. 323–344.



ONE OF THE HOG LIVERS, SPECKED WITH TUBERCULOUS ABSCESSES

PATTI'S LUNGS. TUBERCULAR MASS AT *a*, FULL OF PUS

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that from 30 to 40 percent of the breeding cattle of Great Britain are affected with the disease. The same Commission reports statistics from 29 towns in Saxony where a rigid inspection of slaughtered cattle is maintained, showing that 27.5 percent of the cattle slaughtered in 1895 were tuberculous.

In 1894 a law was enacted in Massachusetts, providing for a general inspection of the cattle of the state. Under this law 21,390 cattle were subjected to the test during the four years, 1894-'97, of which number 11,633 were condemned.[3] The total enumeration of cattle in the state averaged 210,000 for the four years, of which 175,000 were cows. Asuming an annual change of 20 percent in the number of cattle, there may have been a total of 370,000 under inspection during the four years, of which number about 3 percent were found tuberculous. Experience has shown, however, that mere physical inspection does not ordinarily detect half the cases of actual tuberculosis. On this point Prof. Nocard, previously quoted, shows that the number of tuberculous cattle in Denmark ran from 17 percent in 1893, under physical examination, to 40 percent in 1894 under the tuberculin test.

In 1894 the New York State Board of Health tested 27,000 cattle, chiefly within the region supplying New York city with milk, and caused the slaughtering of 845 as tuberculous. This is about 3 percent of the number examined. In 1895 and 1896 this work was placed in charge of a special tuberculosis commission, which reports to the State Board of Health, showing 3,813 inspections for the two years, with 758 reactions, or nearly 20 percent. It appears that the work of this commission was limited to herds in which tuberculosis was suspected; whereas that of the State Board of Health was more general. In 1895 and 1896 the Vermont State Board of Agriculture, acting as cattle commissioners under a special law, tested 14,155 cattle, of which 924, or 4.53 percent, were killed as tuberculous. This work was done at the request of owners of cattle, being commenced in herds where there was some cause for suspecting disease and extended as far as practicable to other herds.[4]

New Jersey established a tuberculous commission in 1895. From the report of this commission for 1897 it appears that they tested with tuberculin 865 cattle during that year, of which number 134, or 15 percent were condemned. It is probable that only suspected herds were examined, but the report at hand is indefinite on this point.[5]

In Connecticut, from January 1st until July 15th, 1896, 2,032 animals

[3] Am. Agriculturist, May 21, 1898.

[4] Report of the Vermont State Board of Agriculture, acting as Cattle Commissioners. 1896.

[5] Report N. J. State Board of Agriculture, 1887-8, p. 154.

were examined by a state commission, and 349, or 17 percent, were found to be tuberculous.[6]

In Rhode Island the State Board of Agriculture is charged with the suppression of tuberculosis in cattle, sheep and swine, but has not been authorized to use tuberculin as a diagnostic, except at the expense of the owner of the animals tested, and therefore has depended upon physical examination. During the four years, 1894 to 1897 inclusive, 2,043 cattle were killed as tuberculous in a state enumerating but 36,000 cattle in January, 1898.[7] In view of the practical certainty that less than half the actual number of tuberculous animals would be found by this method, these statistics indicate a serious prevalence of this disease.

In Pennsylvania the Live Stock Sanitary Board is charged with the examination of herds of cattle in which tuberculosis is suspected, and up to the end of 1897 this board had tested with tuberculin about 16,000 animals, of which 2,500, or more than 15 percent, had reacted.[8]

In a single herd of cattle in Pennsylvania, that of the State Hospital for the Insane, at Norristown, 166 cattle were tested with tuberculin in 1894, and 118, or 70 percent were found to be tuberculous. Attention had been called to this herd by the frequent deaths among the cattle which were supplying the institution with milk and meat.[9]

Comparatively few of the states have as yet provided for systematic inspection of cattle for tuberculosis, but considerable work has been done by state veterinarians and experiment stations in demonstrating the wide prevalence of the disease.

At the Arkansas Experiment Station two herds of cattle were tested in 1895, one of which was found to be free from the disease, but in the other herd of eighteen animals there were four cases of reaction.[10]

The Delaware Experiment Station tested 951 animals during the years 1892-5, revealing 186 cases of tuberculosis, or nearly 20 percent. In discussing these results, however, the Director of the Station points out that the number of cows tested is not yet sufficient to afford an index to the actual prevalence of bovine tuberculosis in the state.[11]

From December, 1893, to December, 1896, the Indiana Experiment Station tested 312 cattle, of which number 7 were condemned as tuberculous.[12]

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[6] Abstract in Report of Maine Commissioners on Contagious Diseases of Animals, 1897, p. 46.

[7] Reports of R. I. State Board of Agriculture, 1894–97.

[8] Pennsylvania Department of Agriculture, Bulletin No. 84, p. 120.

[9] Special Report on Bovine Tuberculosis: State Hospital for the Insane, Norristown, Pa.

[10] Eighth Annual Report, p. 147.

[11] Seventh Annual Report, p. 53.

[12] Bulletin 63.

The Iowa Experiment Station reported in 1895 the testing of 873 cattle in 50 herds, with 122 reactions, or 14 percent.[13]

At the Kansas Experiment Station, in October, 1897, 80 cattle were tested with tuberculin and 15 condemned, the tuberculin test being confirmed by slaughter and post-mortem examination.[14]

The Louisiana Experiment Station tested 22 cattle in 1896, and found 6 tuberculous.[15]

The Veterinarian of the Michigan Experiment Station reports 698 tests in his state up to January, 1898, with 77 reactions, or 12 percent.[16]

In 1896 the Veterinarian of the Minnesota Experiment Station reported 3,430 tests of cattle for tuberculosis, made by himself as the City Veterinarian of St. Paul and Minneapolis, with 380 reactions, or 11.1 percent.[17]

At the Ohio Experiment Station 132 cattle have been tested with tuberculin, and 41 have reacted to the test.

At the Ontario Experimental Farms, including the central farm at Ottawa and three branch farms, located at Manitoba, British Columbia and Northwest Territory, a total of 314 cattle were tested from 1894 to 1897 inclusive, and 98 reacted to the test, or 31 percent. In 1894 the disease was found at all the farms. At the second test, in 1897, only two cases were found on one of the branch farms, but the central farm had been thoroughly reinfected.[18]

The Ontario Agricultural College reports in 1897, 662 tests, made in various parts of the province, with 160 reactions or 24 percent.[19]

During the winter of 1893-4 the herd of 30 cows belonging to the Wisconsin Experiment Station was found to be diseased. The tuberculin test condemned 28 animals and the test was confirmed by autopsy.[20]

These cases are abundantly sufficient to show the prevalence of the disease. They do not, of course, give any accurate information as to the actual percentage of diseased animals in the country at large, since, in most cases, they show the percentage in suspected herds only, and the figures are generally larger than would be indicated by a test of all the cattle in the country.

Government inspectors now stand in all the great stockyards and slaughterhouses where cattle are killed for export, charged with the duty of preventing the slaughter for meat of all animals which are visibly diseased, and of condemning the carcasses of such cases as may have escaped detection before slaughter.

[13] Bulletin 29, p. 253.
[14] Bulletin 79.
[15] Bulletin 43.
[16] Bulletin 133, p. 11.
[17] Bulletin 51.
[18] Reports of Experimental Farms, 1894, p. 58; 1896, p. 89; 1897, p. 70.
[19] Report for 1897, p. 147.
[20] Annual Report, 1894, p. 2.

Dr. D. E. Salmon, Chief of the Bureau of Animal Industry, which is charged with this inspection, replies as follows to a request for information as to the number of tuberculous animals found by these inspectors:

"The number of post-mortems held by this Department at abattoirs throughout the country for the fiscal year ending June 30, 1898, was 4,418,730; 69,000 were condemned by inspectors and 3,163 were found tuberculous. I have not given the antemortem inspections for the reason that all animals rejected in yards are not slaughtered. 14,217 were rejected in yards and 2,892 slaughtered, 310 being found tuberculous."

These statistics would indicate that somewhat less than one animal in every thousand sent to the great abattoirs is condemned for tuberculosis, under the rules of the Bureau of Animal Industry, which only call for condemnation of the carcasses when the disease is found to be generalized. If all the slightly diseased animals were included the number would probably reach two or three per thousand.

The facts given show that bovine tuberculosis is to be found in all countries where cattle are kept, and this revelation seems at first to give a negative answer to the question: — "Is it possible to free our herds from this disease?" But before accepting this answer as final we must remember that the same investigations which have shown the general prevalence of the disease have also shown that in every country there are herds of cattle that are entirely free from it, just as there are human families similarly free in every neighborhood. Even in Denmark, where the average infection is so great that two-fifths of all the cattle tested reacted to the test, yet about one-sixth of all the *herds* tested were entirely free from the disease. The area of Denmark is 15,284 square miles, or approximately three-eighths that of Ohio; but its cattle population was given in 1893 as 1,696,000, as against 1,339,000 enumerated in Ohio the same year, showing that there are about three times as many cattle to the square mile in Denmark as in Ohio. Says Dr. James Law:

"In infected breeding and dairy herds in New York, consisting largely of mature cows, I have found a maximum of 98 per cent and a minimum of 5 per cent. Again, in healthy country districts I have found hundreds of cows in adjoining herds without a trace of tuberculosis among them."[21]

These facts show that it is possible to keep herds of cattle free from this disease, even when surrounded by infected herds; but if it be possible to keep part of our cattle free, under such conditions, it is possible to keep all free.

THE PREVALENCE OF BOVINE TUBERCULOSIS IN OHIO.

In order to obtain information regarding the prevalence in Ohio of bovine tuberculosis, and also to ascertain what action the municipalities of the state have taken on the subject of meat and milk inspection,

[21] Bulletin 65, Agricultural Experiment Station of Cornell University, p. 107.

the following circular was sent out at the beginning of the year to the health officers and veterinarians of the state:

INQUIRIES RESPECTING MILK AND MEAT SUPPRY OF CITIES.

To Health Officers and Veterinarians:

We solicit your kind assistance in obtaining the information called for in the following inquiries. Please fill out the blanks with at least a yes or no — any further information which you may have time to add will be highly appreciated — and return with your name and address to,

Experiment Station,
Wooster, Ohio.

1. Are you aware of the discovery of any cases of tuberculosis among the cattle supplying your city with milk?
2. Has the tuberculin test been applied to any of the cattle furnishing your milk supply?
3. Has your city taken any action looking towards the inspection of the dairies supplying it with milk?
4. Has there been any attempt at meat inspection in your city?
5. Is any investigation being conducted in your city, either by the city or by private enterprise, having for its object to learn whether there is any connection between bovine and human tubercular disease?"

One hundred replies to this circular have been received from points within the state, 15 of which answered the first question in the affirmative, and several others, while replying in the negative to the question as put, reported the discovery of the disease on farms in the vicinity. No reply of any sort has been received from Cincinnati, but those from all but one of the other cities of the state, having a population of 25,000 or over, indicate that the disease has been found, either in some of the herds supplying the cities with milk or in the near vicinity. We quote as follows:

1. "About four years ago the owner of a herd of pure bred cattle came to me for medicine for one of his cows, which was losing flesh and had a bad cough. The cow died two or three months later, and I found on examination a bad case of tuberculosis. A bout a year later he sold a cow to a farmer near town who milked her through the summer and the following winter fed her for beef. When slaughtered she was found to be diseased, and I was called to examine the carcass. I found the lungs, liver and spleen full of tuberculosis and condemned the meat as unfit for food. In the fall of 1896 a farmer bought a bull calf out of this herd. The calf had run with the cow all summer and looked well, but after it had been weaned for some time it began to get poor and finally the owner killed it as worthless. Two other animals from the same herd have proven diseased but are still living, and while no opportunity has been given to test the herd with tuberculin the indications are that nearly the whole herd is affected with tuberculosis. There has been no bad effect from the use of the milk of this herd, so far as we can see; the family seem stout and hearty, yet infection may have taken place long before this, only to prove fatal in the future."

3. "I believe cases do exist among cattle supplying city milk. I have found cattle in the city which I believed to be affected and I think the tuberculin test should be applied." (Cleveland.)

4. The following letter comes from one of the principal grazing counties of the state — a county in which there is no large town:

"I have been examining animals in this and adjoining counties for ten years, and I found a herd of 20 a few days ago that was sound by the test. This herd is the first sound one in that time. My tests show that at least 30 per cent of the milk and meat supply, is more or less affected with tuberculosis. I find calves at 4 to 6 months old, fed from tuberculous cows, badly affected. I have found 33 cases on different farms in cattle alone this last year. Post-mortems showed 30 of this number affected in the lungs and air passages."

8. "There have been several cases of tuberculosis in our county, but the animals were destroyed on discovery of the disease."

10. "I think we have some tuberculosis in this county, but not nearly so much as in some other portions of the state."

32. "About two years ago the health officer made a visit to the different dairy farms and found a few very bad cases in cows that were furnishing milk to the city. In one case a cow was found that weighed scarcely 600 pounds, could hardly stand, had well marked lung lesions, temperature almost 104, and yet the lady owner declared that her milk was excellent and that her baby was doing well on it and could not get along without it."

42. "I have had three cases in my practice, some distance from town. I held post-mortem in two of them which confirmed my diagnosis. I think there is more tuberculosis in cattle around here than the people have any idea of. I have seen a number of cases that looked very suspicious to me, and their milk is being consumed daily."

53. "I have seen a few cows which I have looked upon with suspicion, but I have never used the tuberculin test to confirm my suspicions."

56. "In ten years I have seen 4 or 5 cases of tuberculosis in good Jersey cows and verified my diagnosis by autopsies. These cases were widely separated and in the country. I have been watchful but have seen no person nor animal contaminated from these few cows being thus diseased. I have not seen a case for five years."

66. "Yes. I am not able to say what percent."

67. "A few cases have been discovered but there are probably many more." (66 and 67 from the same city.)

70. "Yes, I know of a number of cases in this vicinity." (Columbus.)

72. "I have met with several cows owned by farmers, which showed symptoms of tuberculosis, but none in our city dairies."

76. "No, but I have just destroyed a fine Jersey bull that has suffered with dysentery for several months. I diagnosed tubercular dysentery and post-mortem revealed the tubercular nodules, well formed and in different stages, in the bowels and also in the lungs."

77. "Last fall I made an autopsy on a cow that died with the disease and am awaiting developments."

79. "One cow in the vicinity afflicted with tuberculosis was promptly killed some two years ago." (In reply to the second question this correspondent writes): "Not necessary to test; our dairy cows are neat, fine, healthy cows as can be found in the state." (But the experience of this Station shows that external appearance is not a safe guide in such cases.)

87. "It exists in herds containing about 150 cows. Cattle in three herds have responded to the tuberculin test." (Akron.)

90. "I believe that Holmes county is almost if not entirely free from tuberculosis in our native cattle. We have only a few large herds and I have had them under close observation for 12 years, and have failed to see any symptoms

of this disease. I have found a few cases in cattle brought in from other parts of the state, which have been destroyed."

91. "I am fully satisfied from the few tuberculin tests I have made here, that the disease is quite prevalent." (Cleveland.)

93. "Not certain, but have every reason to believe that tuberculosis exists to a certain extent."

94. "Am not aware of any cases at present, but have seen cases owned by milk peddlers, and have seen more among cattle furnishing butter."

96. "I have found three cases in my practice of 20 years." (Toledo.)

99. "It was discovered by a veterinary surgeon some time ago. He has since died and nothing further has been done." (Steubenville.)

In addition to the foregoing, several persons give a simple affirmative reply to the question or indicate that they believe that the disease exists in their vicinity but have not positive evidence.

In reply to the second question, only ten correspondents report the use of tuberculin.

Taken as a whole the responses to this circular indicate that bovine tuberculosis has only been positively identified in a few districts of the state, chiefly in the vicinity of the larger cities, where cattle are kept in herds of considerable size. They do not prove, however, that there may not be a much wider distribution of the disease than that indicated, because the tuberculin test has been applied in so few cases that it is impossible to speak with certainty on this point, a fact which many of the reporters recognize. It would seem to be a conservative statement that the disease is to be found in many of the herds of dairy cows supplying our larger cities with milk; that it also exists in some of the country districts, but that there are considerable areas, embracing, possibly, the greater portion of the state, within which it has not yet obtained a foothold

MUNICIPAL INSPECTION OF MILK AND MEAT IN OHIO.

The following replies to the third and fourth question of our circular show the present status of municipal inspection of milk and meat in the state:

2. "For about three years I have been trying to get proper inspection of our dairies and milk supply, but as yet no results have been attained. We have a splendid Board of Health, composed of the best men in the city, but our hands are tied by the city council. Meat inspection is also neglected, yet our sanitary policemen make a haul of fish, etc. at times and also look after some of the dairy yards, but we can get no satisfactory results. I believe that our city councils should take second place when it comes to sanitary regulations. (From the Health Officer of a city of 16,000 population.)

3. "None by the city, but there is governmental inspection of meat here." (Cleveland.) [Governmental inspection applies only to meat intended for interstate or export trade.]

5. "I am sure that you are engaged in a good work, and hope it will be productive of much good. That milk, dairy and meat inspection is of much

importance there is no doubt. In my duties as veterinarian I have seen cattle affected with actinomycous, cancerous and other malignant affections; cases that could not be treated successfully, and have recommended their destruction, but in many cases these same cattle have surreptitiously reached the butcher's block. Our people do not demand meat inspection, and so long as they (as well as many members of boards of health) are not informed as to the various possibilities of infection and danger from diseased, unwholesome or innutritious meat, and so long as they are not convinced of the transmission of diseases of animals to man, but little improvement can be expected. Some of those who are supposed to be guardians of the public health are criminally indifferent; others know better, and I hope the time will soon arrive when municipal meat inspection will be as rigid as the federal inspection is at present. (Coshocton.)

7. "We are furnishing a chemical and bacteriological laboratory." (Youngstown.)

8. "The local Board of Health has had the sanitary policeman visit the dairies several times to see if they were clean." (Xenia.)

14. "We inspect the dairies two or three times a year." (Washington C. H.)

15. "During August the meat markets were inspected once a week." (Wapakoneta.)

18. "There are a great many irresponsible parties delivering milk in our city, but our Board of Health has not taken any steps to ascertain the character of the milk supplied." (Ravenna.)

19. "We inspect all dairy cows, as well as cans, milk houses, etc. and also test milk taken from wagons in the street. This is done every month. We also inspect all slaughter houses and meat markets every week." (Tiffin.)

21. "During the summer the Board of Health took the matter up and there was an effort made, supported by the physicians, to get a milk inspector; but as the city had no funds to pay an inspector none was appointed. I am not sure that any attempt has ever been made at meat inspection in this city." (Springfield.)

22. "A veterinarian accompanied the committee of the Board of Health when examining the cows and stables of the dairies supplying the town with milk." (Sidney.)

23. "Only by getting samples of milk from the wagons." (Sandusky.)

27. "All milk sold in the village has been inspected during the last month, and dairies will be inspected in a short time. There is no systematic inspection of meat. It is a matter the Health Officer is expected to look after." (Reading.)

29. "Dairies are inspected once a year." (Warren.)

31. "An unsuccessful attempt has been made at meat inspection. No milk inspection." (Circleville.)

34. "Regular ordinary inspection of cows, stables, dairy products and meats provided for." (Portsmouth.)

37. "General attention of Health Officer and examination of milk by ordinary tests. Ordinary inspection of meats." (Piqua.)

43. "Dairies are inspected frequently. General inspection of meat." (Niles.)

49. "There has not been any action taken anywhere in Northwestern Ohio, outside of the larger cities, and I am sure the people here eat lots of diseased meat." (Leipsic.)

54. "I was appointed milk and dairy inspector over two years ago, but only with a view to getting our village supplied with clean, natural milk. Thus far we have accomplished much, but no scientific test has been made to determine whether or not our cattle are affected with tuberculosis. At the same time I was also appointed meat inspector, but to look after its cleanliness only, rather than its healthfulness." (Kent.)

56. "Only that our sanitary policeman regularly visits butcher shops and slaughterhouses." (Hillsboro.)

58. "No inspection. I have recently seen cholera hogs and tuberculous and actinomycosis beef upon the butcher's block."

59. "No inspection. I have been a careful observer of our markets, slaughterhouses, etc., and have noted in one instance pearly tuberculosis of the pleura, and several times animals in advanced stages of pregnancy. We have frequent deaths from acute tuberculosis."

64. "Dairies are inspected twice a year, March and September. The milk is tested by the Babcock system. The city has a meat inspector, who inspects the animals before they are killed and the meat in the markets." (Findlay.)

65. "Nothing more than that given by our sanitary police." (Elyria.)

67. "We now have no Health Board. Meat inspection is conducted only in the ordinary manner by one inspector, and he has very little authority or support." (Dayton.)

68. "Dairies are inspected. During the two years since inspection has been required there has been a marked improvement in both stock and milk." (Cambridge.)

69. "The Board of Health has rules governing the inspection of dairies, barns and milk, but has never had an inspector." (Ashtabula.)

70. "I think very little attention is directed to the dairies. We have a milk inspector who sometimes tests the milk as it is delivered in the city. The same person is supposed to look after the meat." (Columbus.)

78. "The Board of Health officers visit all dairies once a month and inspect all cows." (Bucyrus.)

79. "The dairy cows and all environment of barns, feed, water, pasture and milk houses are closely watched." (Bryan.)

80. "The meat and milk supply for this city is just what the dealers give us. 'Your eyes are your bargain' with us, and if bad meat and watered milk are foisted upon you, then try another market." (Bellaire.)

91. "No; but our Health Officer is heartily in sympathy with the work. (4) Only a market inspector." (Cleveland.)

95. "To some extent." (Delaware.)

99. "None whatever. Population about 16,000. Cows have been sick and some have died. I do not know what the disease was, as I am not a veterinarian." (Steubenville. Another report from this city states that bovine tuberculosis has been identified in some of its dairies by means of the tuberculin test.)

In several cases these questions are answered by a simple affirmative and in one or two cases it is stated that ordinances providing for inspection are being considered, but the reports show that the vast majority of our people are altogether neglecting to avail themselves of the partial protection from unwholesome food which the law places within their reach, while in those cases where inspection of some sort is attempted it is generally inadequate. Take the case of Columbus, for example, a city of more than a hundred thousand people, with *one* inspector for both milk and meat supply!

BOVINE TUBERCULOSIS IN ITS RELATION TO THE PUBLIC HEALTH.

The statistics of the eleventh census of the United States show that 49,844 deaths occurred in Ohio during the census year. Of this number, 6,884, or 14 percent, were ascribed to tubercular diseases, including consumption, hydrocephalus, scrofula and tabes; these last named diseases, together with diseases of the bones and joints, being classed as generally tubercular in character. Of the deaths from this group of diseases, 382, or 5 percent of the whole number, occurred before the age of two years. For the next thirteen years of life the average deaths from tubercular diseases averaged only 27 per annum; but for the 20 years following, that is between the ages of fifteen and thirty-five, more than one-third of the deaths from all causes were due to this one fearful scourge, the proportion rising to 40 percent during the ten years, between the 20th and 30th years of age, the period covering the radiant middle forenoon of life, when life is sweetest and its possibilities are greatest. Says Dr. James Law:

"If the 5,490 deaths from tuberculosis, which occur every year in the city of New York, could be brought together in an epidemic lasting but one week, no smallpox, cholera nor yellow fever scare would approach the panic which would thus be created; for when did all three diseases together create such mortality in this city? Nay, if we take the whole civilized world and compare with the tuberculosis mortality all the accumulated deaths from war, famine, plague, cholera, yellow fever and smallpox, we find that the latter are comparatively insignificant. Yet, tuberculosis, like every germ disease, is absolutely preventible, and is allowed to continue its career of death only because of reprehensible ignorance and criminal indifference."[22]

During the middle ages consumption was regarded as a contagious disease, and the possible identity of this disease in animals and men was recognized in laws in Italy and Spain, which, according to Dr. Law,[23] are still in force, prohibiting the use of tuberculous carcasses for human food.

At a more recent period the theory of contagion in consumption was almost completely displaced, in our country at least, by that of heredity, and when families were swept away by this scourge it was taken as a manifestation of this great law of life.

In 1865 Villemin demonstrated the communicability of tuberculosis by producing the disease in rabbits and guinea pigs through inoculation, and in 1882 Robert Koch, of Berlin, published his epoch-marking discoveries previously referred to.

[22] Cornell University Agricultural Experiment Station, Bulletin 65.
[23] Ibid.

THE IDENTITY OF TUBERCULOSIS IN MAN AND THE LOWER ANIMALS.

For centuries it has been observed that many of the lower animals are affected with a tuberculous disease, similar in its manifestations to consumption or scrofula in the human subject, and the identity of the disease has been suspected, as shown by the laws already alluded to. The possibility of transmitting human tuberculosis to the lower animals has been demonstrated by a multitude of experiments since its first discovery, both by inoculating animals with tuberculous materials derived from man, and by feeding them such materials. The counter proof of the communicability of the disease from animals to man is more difficult of demonstration, especially because of the insidious nature of the disease, on account of which its germs may lie apparently dormant in the system after infection, even for years, before distinctly manifesting their presence; but the facts that the bacteriologist is unable to discover any specific difference between the tubercle bacillus found in man and those found in the various domestic animals, and that the manifestations of the disease and the lesions produced by it are so closely alike in all cases,[24] together with the many instances reported since physicians have had their attention turned in this direction, in which the development of tubercular disease in persons, chiefly children, has followed in close sequence upon the use of the milk of tuberculous cows, leaves no room for reasonable doubt that one form, at least, of tuberculosis is common to man and beast. I quote a few cases of this character.

Dr. James Law says, in the bulletin previously referred to: "In the practice of Dr. Stang of Amorback, a well developed, five-year-old boy, from sound parents, whose ancestors on both male and female sides were free from hereditary taint, succumbed, after a few weeks illness, with acute miliary tuberculosis of the lungs and enormously enlarged mesenteric glands. A short time before the parents had their family cow killed and found her the victim of advanced pulmonary tuberculosis. (Lydtin.)

"Dr. Demme records the cases of four infants in the Child's Hospital at Berne, the issue of sound parents, without any tuberculous ancestry, that died of intestinal and mesenteric tuberculosis, as the result of feeding on the unsterilized milk of tuberculous cows. These were the only cases in which he was able to exclude the possibility of other causes for the disease, but in these he was satisfied that the milk was alone to blame.

[24] The report of the Massachusetts Board of Cattle Commissioners for 1897 contains a report of experiments made by Dr. Theobald Smith, in which cattle inoculated with cultures of tubercle bacili derived from bovine tuberculosis showed, at the end of two months time, extensive tubercular infection, whereas other cattle, inoculated with cultures derived from the sputum of human tuberculous subjects, furnished only very slight evidence of such infection.

From these experiments Dr. Smith concludes that bovine tubercle bacilli and human bacilli as found in sputum are not identical, and that there is probably but little danger of cofumigating tuberculosis to cattle through the sputum of tuberculous attendants.

It would seem, however, that no difference greater than that of variety can be claimed from these experiments, for it seems that tubercular growths were found in the cattle inoculated with the human sputum, though their state of development, at the end of two months, was far inferior to that from tubercle cultures of bovine origin. The experiments were of too short duration to show what might have been the condition of the cattle at the end of one or two years—a very important point in the study of a disease so slow in its development as tuberculosis is frquently found to be.

Admitting that a varietal difference is shown, which is all that is claimed for them by Dr. Smith, these experiments throw no definite light upon the communicability of bovine tuberculosis to man, nor do they afford any conclusive evidence that bovine tuberculosis might not be more dangerous to man, as well as to cattle, than the human variety.

"After a lecture of the author's at Providence, R. I., a gentleman of North Hadley, Mass., a graduate of the Massachusetts Agricultural College, publicly stated that his only child, a strong, vigorous boy of one and one-half years, went to an uncle's for one week and drank the milk of a cow which was shortly after condemned and killed in a state of generalized tuberculosis. In six weeks the child was noticeably falling off and in three months he died, a mere skeleton, with tuberculosis of the abdomen. The father could trace no tuberculosis among his near ancestors, but the mother's father and uncle had both died of it. She remains in excellent health.

"Dr. E. O. Shakespeare (Med. News, March 26th, 1892) attributed one-fifth of all deaths in infants and young children, feeding on milk, to tuberculosis, usually commencing in some part of the digestive organs.

"The identity of tuberculosis in cattle and in man is abundantly proved in the above instances of the infection of man through the milk and in the hundreds of cases in which the tubercle of man has been successfully inoculated on the lower animals. As evidence of direct transference of the disease from cattle to man by inoculation the following two cases are quoted:

"Tscherming, of Copenhagen, attended a veterinarian who had cut his finger in making a post-mortem examination on a tuberculosis cow; the wound healed but there remained a swelling which soon ulcerated and refused to heal, so that the whole tumefied mass had to be cut out. The microscope revealed the distinct tubercular process and the presence of the characteristically staining bacilli.

"Pfeiffer attended a Weimar veterinarian of the name of Moses, 34 years old, of a good constitution, and without hereditary predisposition, who, in 1885, cut his right thumb deeply in making a post mortem examination of a tuberculous cow. The wound healed but six months later the cicatrix still remained swollen, and in the autumn of 1886 the man had pulmonary tuberculosis with bacilli in his sputa and death occurred in two and a half years after the wound. Post-mortem examination revealed tuberculosis of the joint of the wounded thumb, and in the lungs extensive tubercles and vomicæ.

"To Tscherming's may be added the case of a young veterinary friend of the writer, who was inoculated in the hand in opening a tuberculous cow, and suffered from a tumefaction of the resulting cicatrix, with distinct tubercle bacilli. The surgical removal of the tumefaction manifestly saved the subject from a generalized tuberculosis."

In addition to the foregoing, I quote the following instance from Bulletin 42 of the Vermont Experiment Station:

"A child four years old, great grandson of Henry Ward Beecher, died last March at Yonkers, N. Y., of tubercular meningitis. The diagnosis was confirmed by specialists. There were no hereditary tendencies to the disease known. The certainty that he had the disease, and the inability to account for it from human agencies, led the physicians to suspect the milk of the two Alderney cows, on which the child had been mainly fed. Both the tuberculin test and the post-mortems showed that both animals were tuberculous. Through the kindness of Dr. J. S. Lamkin of Yonkers, who made both tests and post-mortems, sections of the lungs and a gland were sent to us. They were found to be highly tuberculous."

Dr. M. Stalker, veterinarian of the Iowa Experiment Station, reports the death from consumption of five young people, between 20 and 30 years of age, in one family during a period of two years. Not a trace

of the disease had ever been known in the family of either the father or mother of the victims. On the farm where the deaths occurred he found 17 cases of tuberculosis in the herd of cattle, and others had died before the investigation was made. In another case, reported by the same authority, a mother and child died; "The mother from undoubted consumption, and the child from intestinal trouble highly suggestive of the same disease. The cow that had supplied milk to the mother and child was tested and found to be tuberculous. Post mortem examination of the cow revealed a badly tuberculous condition of the udder."[24]

In the year 1890 Dr. Harold C. Ernst, of the Harvard Medical School, under direction of the trustees of the Massachusetts Society for Promoting Agriculture, sent out to about 1,800 medical and veterinary gentlemen a circular, inquiring whether they had ever seen cases of tuberculosis which it seemed possible to trace to a milk supply as a cause. A thousand replies were received, only few of which gave well confirmed instances of the transmission of this disease through cow's milk to human beings; a considerable number reported suspicious cases, and many expressed their belief in such transmission, but stated that they were unable to offer evidences in support of such belief, that would be accepted as scientifically satisfactory.

Some of the uncertainties in such an investigation are to be found in the fact that the disease may be latent in the system for years, when the subject takes what is commonly called a cold and develops other symptoms which may be ascribed to atmospheric influence and not to the food supply. Or, in the case of the dwellers in cities, there is usually no possibility of tracing the milk to its source and thus determining its character; but the chief difficulty in this investigation seems to have been due to the lack of interest in the matter on the part of a very large proportion of the medical gentlemen consulted.

Among the cases of suspected transmission of tuberculosis through cow's milk to children reported by Dr. Ernst are the following:

Dr. A. B. Coffin, of Roxbury, reports the case of a baby in a family with no past history of tuberculosis, which "never prospered, lost flesh, developed a bronchitis and large belly, much swollen." The general symptoms indicated tabes mesenterica. The baby was fed on a Jersey cow's milk, uncooked. The cow died and the baby soon after, but no opportunity was given for post-mortem examination in either case.

Dr. Israel T. Dana, of Portland, Maine, writes: "I have had cases of infants brought up on cow's milk, when neither heredity nor environment would lead to the expectation of tuberculosis, in which tuberculous symptoms have rapidly developed, with fatal terminations. The symptoms have oftener been abdominal than pulmonary."

Dr. J. Arthur Page, of Lowell, Mass., reports the death of a child from tubercular meningitis. The family history was good, and the food consisted (aside from breast milk) only of milk from one cow. Rabbits inoculated with

[24] Iowa Agricultural College Experiment Station, Bulletin 29

this cow's milk, died, but no definite sign of tuberculosis was found in the cow. This, however, was before the introduction of the tuberculin test.

Dr. Geo. H. Bailey, State Veterinary Surgeon, Portland, Maine, writes: "I have a case now under observation where about a year ago I condemned a tuberculous cow, that proved upon post-mortem to be an advanced case of pulmonary tuberculosis. The milk from this cow was the sole supply of the family (a man and his wife) and although there is no history in the family of the woman that can possibly be traced to pthisis, she is in an advanced stage of consumption, as I have every reason to believe from the direct use of the milk from the cow that I condemned."

Dr. N. Senn writes: "I have seen a number of cases of intestinal tuberculosis in children fed on cow's milk, in which other causes could be excluded."

Dr. G. T. Whittaker, of Cincinnati, states that he has had one or two cases of basilar meningitis, secondary to intestinal affections and independent of bronchial catarrh, in new houses, parents and attendants free from all signs of the disease, with no trace of it even in remote ancestry, and the surroundings (rural) perfectly good. The milk was taken from one cow in each case, and intestinal catarrh was the forerunner of the meningitis.

Dr. C. H. Peabody, Veterinary Surgeon, Providence, R. I., reports the case of a cow which gradually went down with evident symptoms of tuberculosis. He advised her destruction and remonstrated against the use of the milk, but with no avail, the family continuing to use it. The cow finally died and autopsy showed generalized tuberculosis. A few months later the baby of the family died, and post-mortem examination showed tubercular deposits in brain and lungs; two years later a child, three years old, died with tubercular bronchitis, and a few years later a boy nine years old, who had been delicate for three or four years, died with "quick" consumption. The parents and grandparents of the children were all rugged and healthy people.

Dr. A. R. Rose, D. V. S., of Littleton, Mass., reports the case of a child that died with tuberculous symptoms after living upon the milk of a tuberculous cow.

Dr. Edward T. Williams, of Roxbury, Mass., writes: "I think I have seen many examples of tubercular disease from milk, mostly in hand-fed babies of perfectly healthy parentage, developing tabes mesenterica, pthisis, and tubercular meningitis, yet I cannot prove it scientifically in any case."

Numerous others write to the same effect. For instance, Dr. F. Forchheimer of Cincinnati, writes: "According to my notion, tuberculosis is by far the most common of children's affections, — again, most common in a localized form. The place where it is most frequently found in them is somewhere in the alimentary tract or organs connected with it. Milk is the most common article of diet in children; milk contains tuberculous material to an extent which, according to my idea, is not properly estimated, so that I have the conviction that tuberculosis is frequently caused by milk. As to a record of cases of this connection, or scientific proof of the same, I should hesitate a very long time before I would put down any individual case as in evidence. Cases are not uncommon, in practice, in which a tuberculous mother nurses an infant which dies, let us say, of meningitis tuberculosa. Yet, in such a case, in which I am convinced that the mother has transmitted tuberculosis to her child, how can I present evidence sufficiently conclusive to prove that the infection has not come from another, extraneous source? I have seen children who, according to the statement made to me, have had no other food but milk, with the following set of lesions: tuberculosis of the glands about the neck, of intestines, mesenteric glands, lungs, and meninges. I am justified, I think, in the conclusion that the tuberculosis

was produced by a something introduced into the alimentary canal. I am convinced that it was by means of milk, yet I am not justified in this individual case in stating that this was the cause to my knowledge. In other words, I cannot put down such a case as one capable of exact demonstration."[25]

If it be true that human and bovine tuberculosis are identical, then we should expect to find human tuberculosis more prevalent among people who keep cattle largely, and use their flesh and milk for food. Upon this point I quote from the report of the New York Commission on Tuberculosis in Cattle, as given in the Fifteenth Annual Report of the New York State Board of Health:

"Broad generalizations of our knowledge show a close parallelism between the numbers of dairy cows and the prevalence of tuberculosis in the human race. Countries that have few or no cattle, or in which the herds are mainly kept in the open air, and are, therefore, largely protected from the disease, show as a rule little tuberculosis in man. Thus phthisis is rare in the Scottish Hebrides, Iceland, New Foundland, Hudson Bay, Northern Norway, Sweden, Lapland and Finland, China, Japan, the Kirghiz Steppes, and most of the Pacific Islands. Striking exceptions have to be made which are in themselves very instructive. The Sandwich Islands have become an exception since the introduction of European cattle. Australia and Tasmania, which 30 years ago were considered as incompatable with consumption have, under the advent of phthisical persons and an extensive ranching, become almost as tuberculous as England itself.

"In the Kirghiz Steppes the Tartars keep horses rather than cattle, eating their flesh and drinking their fermented milk, and they rarely suffer from tuberculosis. In Italy, on the contrary, in the balmiest climate of Europe, the consumptives congregate from all points; the numerous cattle are kept, to a large extent, indoors, and Perroncite pronounces tuberculosis as a veritable scourge for man and beast. In the early days of its settlement, Minnesota was looked upon as nature's sanitarium for the consumptive, but now with the advent of domesticated herds, tuberculosis has become about as prevalent as elsewhere. In China the ruling Tartar race, eating beef and milk, suffer largely from tuberculosis, whereas the poor aboriginal Chinese, living mainly on rice, are but rarely attacked. The same exemption is largely the prerogative of the vegetarian Japanese. Holden tells us there is little or no consumption in Columbia, where little milk and no butter is used, and that the same is true of Ecuador and the internal parts of the Argentine Republic.

"When we turn to our own American Indians, the reverse of this picture appears in all its hideousness. These are in the habit of eating raw the cattle provided for them, and which, being bought in the cheapest markets, are not always sound. Dr. Holden, in the Medical Record for August 13, 1893, tells us the result. At Green Bay, Wis., Tualip, W. T., and Western Shoshones, Nev., tuberculosis causes 50 percent of the total Indian mortality. Dr. Treon, in the American Practitioner, refers to the consumption of the raw diseased meat at the Crow Creek Agency, in these terms: 'Saturday, early in the morning, the cattle are shot down in the corral, and the Indians drag them out, skin and cut them up. I have observed them frequently, when slaughtering, eating the warm liver, tallow and even the entrails, and great quantities of raw beef. In fact, much of the beef is dried, pounded up and eaten without cooking. Frequently they eat

[25] Infectiousness of milk. Result of investigations made for the trustees of the Massachusetts Society for Promoting Agriculture. Published by the Society. Boston, 1895.

animals that have died of disease days before, and, to my mind, here is a good solution of the trouble: Supposing that only one out of a thousand cattle received be affected with tuberculosis or actino-mycosis, from the manner of dividing the beef it is possible, and probable, that 100 persons may become inoculated by a single diseased animal.' These are extreme examples, it is true, but they are terribly significant when taken in connection with the fact that the one essential cause of tuberculosis is the living germ, and that this germ is indistinguishable in the diseased animal and in man. It matters not to tell of the overcrowding and unhygienic condition in which these Indians live. The Esquimaux live in huts just as close throughout a still longer winter, but in the absence of the infected food show no such terrible results."

The question may now be raised, why is it, if this disease is really communicable from animals to man, that it has taken so long to establish that fact? The answer is to be found in part in the narrow field occupied by the practice of medicine until a very recent date. Although Hippocrates, Columella and others wrote concerning the diseases of animals, such diseases were not considered worthy the attention of the student until 1761, when the first veterinary school was established at Lyons, and it was thirty years later before a similar school was permanently established in England. Up to this time the farrier was the only veterinarian, except when his field was encroached upon by the professional quack.

This state of affairs gradually gave way to a somewhat improved condition in Europe, as the veterinary schools began to turn out men having better qualifications for their work; but men of middle age will remember the time when in Ohio the local "horse doctor" was probably one of the most ignorant men in the community, and when the average practitioner in human medicine felt it to be altogether beneath his dignity to study the diseases of the lower animals.

The practice of veterinary medicine will always remain a separate vocation from that of human medicine; but both must now be built upon the same broad foundation which has been laid for them by the comparative anatomist and physiologist.

This former disregard of the lessons which might have been learned from a careful study of the forms of disease in the lower animals was perhaps the chief cause of failure to recognize fully the identity of tuberculosis in man and animals. Another cause is found in the insidious nature of the disease, already referred to, rendering it possible for the visible outbreak to be delayed for an indefinite period after the actual infection has taken place, or causing the disease to be communicated by animals which themselves appear to be in the most perfect health; for it is one of the singular characteristics of this malady in cattle that the healthiest appearing animal in the herd may be seriously affected with tuberculosis.

The general belief in the heredity of consumption has also contributed to obscure its true nature. In the light of our present knowledge

we must abandon this belief, unless we include congenitalism under the general term, heredity. Possibly there may be pre-natal transmission of tuberculosis from parents to their immediate offspring; but this transmission must be regarded as of the same character as infection, and not at all as due to that law by which physiological and psychological characteristics are transmitted from generation to generation, further than that the physiological peculiarities favorable to the disease, if there are such, may be thus inherited. Even congenital transmission is doubted by so good an authority as Carl Frænkel, who denies that "a single indubitable case of congenital tuberculosis (established before or during birth) has thus far been observed in man." Referring to the discovery of tubercle bacilli in the embryos of cattle he says:

"But we can surely object that these observations are decided exceptions to the rule. We are far from saying that such a thing cannot happen, but it has as yet not been established, and all cases of tuberculosis occurring during the first months of life thus far communicated have proved open to the suspicion that they are the result, not of an inherited affection, but of one acquired at a very early period, i. e. a genuine infection."[26]

In illustration of this point I have compiled the following table from the reports of the Eleventh Census of the United States, showing for Ohio the total annual deaths from all causes at different ages of life, the total deaths ascribed to consumption, hydrocephalus, scrofula and tabes combined, and the proportion which these bear to the whole. Hydrocephalus is classed in the census with tubercular meningitis, in the belief that most cases of death ascribed to hydrocephalus are due to tubercular meningitis. Scrofula and tabes are now also looked upon as essentially tubercular diseases. Hydrocephalus, scrofula and tabes are especially destructive in the earlier years of life, and therefore it is necessary to consider them in a study of tuberculosis by age periods. These do not exhaust the list of tubercular diseases, as certain diseases of the bones and joints should be included, and it is probable also that a considerable proportion of the deaths ascribed to diseases of the bowels and liver, to debility and atrophy, to bronchitis and to diseases of the brain other than those mentioned are due principally to tubercular infection. On this point Dr. E. O. Shakespeare, of the University of Pennsylvania, has expressed the belief that one-fifth of all deaths in infants and young children, feeding on milk, are due to tuberculosis, usually commencing in some part of the digestive organs.

The table gives the figures for each year separately under five years of age, and for the annual average of the five-year periods following that age:

[26] Textbook of Bacteriology, Linsley's translation, 1891, p. 245. Since this was written, however, there have been reported a few cases in which congenital transmission seems to have been well established.

DEATHS IN OHIO DURING THE CENSUS YAER AND PROPORTION DUE TO TUBERCULAR DISEASE.

Age periods.	Deaths for each age-year.		
	From all causes.	From tubercular disease.	
		Total.	Percentage.
Under 1 year	10,274	245	2.38
1 to 2 years	2,662	137	5.14
2 to 3 "	1,409	45	3.19
3 to 4 "	973	32	3.19
4 to 5 "	732	32	4.37
5 to 10 "	436	21	4.82
10 to 15 "	227	29	12.78
15 to 20 "	359	116	32 31
20 to 25 "	484	196	40.49
25 to 30 "	438	174	39.72
30 to 35 "	892	138	35 20
35 to 40 "	376	118	31.38
40 to 45 "	348	96	27.87
45 to 50 "	335	77	22 97
50 to 55 "	356	59	16.57
55 to 60 "	376	56	14.63
60 to 65 "	441	49	11.11
65 to 70 "	504	49	9.72
70 to 75 "	524	41	7.82
75 to 80 "	466	21	4.51
80 to 85 "	348	10	2.81
All ages			

This table shows that more deaths occur from tubercular diseases before the first year of life is ended than during any following year, although the percentage of such deaths to the total mortality is comparatively small, owing to the tremendous destruction of life from other causes at this period, a destruction amounting to one-sixth of all the deaths in Ohio, as shown by our state statistics, and extending to twice that proportion in some of the foreign born populations of the cities, as shown by the statistics of the National census.

As already suggested, it is probable that the figures for the deaths from tubercular diseases in early childhood are much too low, and that their exhibit of the enormous loss of life, as compared with the relatively smaller losses between the third and fifteenth years, is far below, rather than above the truth.

Congenital infection might account for these early deaths if there were no more probable hypothesis; but the fact that the absolute demonstration of such infection has been so rarely if ever made, while the opportunities for external infection are so very great, must lead us to doubt whether even congenitalism, saying nothing of heredity proper, plays any important part in the propagation of this disease. If the disease were largely of congenital origin we should expect to find a condition of affairs in cattle similar to that shown by human statistics; but in fact, tuberculosis is extremely rare in cattle under twelve months of age, and is practically unknown at the age which would correspond to the first year of human life. When found in cattle under a year old it may be almost invariably traced to the milk of tubercular dams or to close association with older tuberculous cattle.

Bang of Denmark reports the case of a herd of 208 cows in which 80 percent of the cows and 40 percent of the calves were found infected. The infected animals were then isolated and their calves removed immediately after birth, placed in disinfected stables and fed with boiled milk, after which they remained free from the disease.[27]

Voges calculates, from the examinations of nearly 2,000,000 calves, butchered in various German cities, that only about one in 200,000 had inherited tuberculosis.[28]

Nocard reports that in a region where 15 to 25 percent of the cows were affected only 1 per thousand of tuberculous calves were found, and from other tuberculin studies where 40 to 80 percent of the cattle were affected calves from 4 to 15 months old were not found diseased. In one case, of 44 calves, 6 to 18 months old, 33 were sound, and of the dams of these 26 were tuberculous.[29]

At the Ohio Station the calves are taken from their dams at 3 days of age, and fed by hand thereafter. In one case we have purposely

[27] Abstract of report in Experiment Station Record, Vol. VI, p. 574.
[28] Ibid, Vol. IX, p. 993.
[29] Ibid, Vol. X, p. 94.

produced tuberculosis in a calf under 6 months of age by feeding it milk from tuberculous cows, and we have had two cases of development of this disease in calves at 4 and 5 months of age; but in both cases the dams were in advanced stages of tuberculosis, and the calves had been fed on their milk untreated for the first three days after birth, although receiving only pasteurized milk thenceforth.

It is evident, from these investigations, that the great majority of calves are born free from this disease, even from infected dams, and there would seem to be reason to believe, with Frænkel, that the same law may hold good in the case of children, and that the mortality of infants and young children from tuberculosis may be due almost altogether to post-natal infection.

Such infection has been shown to come through the milk of tuberculous mothers; through the kissing of tuberculous nurses and friends; through handkerchiefs which have been used by the tuberculous; through the accumulation of tuberculous dust in living rooms — and here let me again refer to Frænkel, who quotes the experiments of Cornet, which showed that the dry, powderly dust found on the floors and in the recesses of dwellings inhabited by consumptives almost invariably produced tuberculosis when injected into the peritoneal cavity of guinea-pigs; the diseases beginning in the abdominal organs and only slowly, if at all, extending to the lungs, which are the organs first affected in the spontaneous tuberculosis of these animals. When the inoculating dust came from places where there had been no consumptives the animals showed no symptoms of tuberculosis. Cornet further showed that the chief vehicle for the distribution of tuberculous material is the handkerchief, on which it dries and from which it is unthinkingly shaken off. Dr. J. H. Kellogg, of Battle Creek, Mich., gave a striking instance of such infection, in a paper read before the National Live Stock Sanitary convention held in Washington, in June 1894.

The statistics of the eleventh census show with remarkable reiteration that the death rate from consumption is lowest among the native-born whites of native-born parentage; that when either of the parents is foreign-born the death rate increases; that there is a still further increase when both parents are foreign-born, and that the rate is more than three times as high among the colored as among the native-born whites of native parentage. In other words, the death rate from consumption is lowest among peoples of cleanliest habits and highest among those of opposite habits.

Immunity from consumption is not to be secured by personal cleanliness alone, however. The half swept floors of public halls; the too often not half swept stairways and corridors leading to business offices; the sidewalks, rendered filthy by the expectoration of heedless passers-by, all these are sources of contamination which the cleanliest cannot wholly

escape; and when the children which have escaped the disease at home are started to school they begin running a gauntlet of infection, the risks of which will constantly increase as they grow older and gradually enter upon the busy work of life.

On these grounds it is easy to account for the rapid increase in deaths from tuberculosis at the age when this increase is shown by the statistics; but there can hardly be room for doubt that the enormous infant mortality from this disease is due, not only to the causes mentioned, but also to the use of milk from tuberculous cows.

In the hope of obtaining additional information upon this last point the following circular was sent in November, 1898, to the physicians of Ohio.

OHIO AGRICULTURAL EXPERIMENT STATION.

INQUIRIES RESPECTING TUBERCULAR DISEASE.

To Physicians:

Please reply to these questions with at least a yes or no (it is hoped that you will find time to give additional particulars), and mail, with your address, to

Experiment Station, Wooster, O.

1. Is your practice chiefly in the city or country?
2. Have you found bottle-fed infants to be relatively more subject to tubercular disease than those nourished exclusively at the breast?
3. Have you been able to trace any cases of tubercular disease to the milk of unhealthy cows? If so, please give particulars.
4. In the case of bottle-fed infants, have you observed greater or less frequency of tubercular disease among those fed from single cows than among those receiving the mixed milk of large herds?
5. Have you had reason to suspect the origin of tubercular disease in older children or adults to be in the milk or meat supply? If so, please give particulars.
6. In the case of breast-fed infants have you observed tubercular disease when the mother was not herself tuberculous?
7. If so, was there a tuberculous attendant or frequent visitor?
8. Or, had the house been previously occupied by a tuberculous person?
9. Have you had any reason to suspect the communication of tubercular disease from infants to adults?

Three hundred and thirty-nine replies to this circular have been received from physicians practicing within Ohio.

Of these replies, 116 were based upon city practice, 153 upon country practice and 67 upon both.

One hundred and thirteen physicians answered the second question in the affirmative and 189 in the negative. Of those who reply in the affirmative many add the qualification that bottle-fed infants are more subject to all diseases, while many of those who reply in the negative are physicians practicing in the country, who state that they have had either too few bottle-fed infants, or too few cases of infantile tuberculosis under their observation to justify conclusions on this point. On the other hand, two or three physicians record the observation that bottle-fed infants are less liable to tubercular disease than those nourished at the breast; others modify this by the qualification "provided the milk is sterilized," and many say that the bottle is safer if the mother is tuberculous.

Affirmative replies to the third question are given by 22 physicians, and to the fifth by 33. Several cases are reported in which the sequence of tubercular disease upon the use of infected milk or meat is so close as to leave little doubt that the disease has been acquired in this manner, but the difficulty of producing a scientific demonstration of this causal relationship is alluded to by them and by others, who state their belief in the communication of the disease through the food, but can furnish no facts in support of that belief.

In answering the fourth question, the great majority state that they have observed no difference between the milk of single cows and that of herds. Many write from the cities that mixed milk is the only milk available, while those from the country usually state that no large herds are kept. Forty-one express a preference for the milk of single cows, and 32 for the mixed milk of herds.

Of the 339 reports, 109, or less than one-third, have observed any cases of infantile tuberculosis when the mother was not herself tuberculous; 49 of these observers knew of there being a tuberculous attendant — the father in nearly half the cases, frequently aunts or sisters or other relatives — or of the house having previously been occupied by tuberculous persons, and 39 more were doubtful upon these points, while 21 answered both questions by a simple negative.

In answering the seventh and eighth questions many intimate that attention had not been drawn to these possible sources of infection; on the other hand, in several cases tubercular disease of adults is ascribed to contaminated houses.

Twenty-eight report observations of tubercular disease from infants to adults, and 34 have observed its communication from one adult to another.

Taken as a whole, the great majority of these replies from physicians indicate a belief in the contagiousness or infectiousness of tubercular disease and its possible communication from cattle to men through the medium of milk and meat.

Many of the physicians, in replying to the circular, added observations of great value, which are here given in condensed form, the prefixed numbers indicating the order in which the replies were received, and the numbers in parentheses referring to the questions. In the case of the omitted numbers the replies were limited to a brief affirmative or negative. The place from which the reply was received is given at the close, and the character of the writer's practice is indicated by the words "city," "country" or both.

2. An Irish family nearly all died with consumption about the years 1883 to 1887. The father and mother were both born in Ireland, of healthy parents. The first girl took sick about the year 1883, with well developed tuberculosis, and died. Two other girls afterwards died of the same disease, also the father.

One boy and girl still living. I can only account for this in the milk and meat supply and unhealthy surroundings. (Orrville. Both.)

3. Tuberculous patients should be prohibited by law from expectorating in public places and should be provided with something to destroy the germ which is expectorated. (Coshocton. Both.)

4. A father had tubercular disease and would expectorate on floor and wall and his babe took it and died, as well as his wife and two others of the children. (Wapakoneta. Both.)

7. We have here almost every nation represented, Chinese excepted, and of course they nurse their children if possible, hence I have not had extensive experience with bottle-fed infants. (6) Yes, but two older children had it, with a father dead from most malignant tuberculosis. (Ashtabula. City.)

9. I have a case of an infant whose father died of tuberculosis and whose mother was infected. I never permitted it to nurse the breast. First it was fed on malted milk, later on cow's milk (from one cow) and barley water, and it developed more rapidly than any baby I ever had in charge. It is now about 17 months old. Another: Both parents died of tuberculosis. Fed the babe on cow's milk and barley water, but it was kept much of the time in infected rooms, contrary to orders. It developed tubercular meningitis; recovered from the first attack but had a second four months later and died. (Crestline. Both.)

22. (7) An aunt came into a house and two children died, soon after she did, with tuberculosis. (8) I have seen cases of tuberculosis where the cause was paper in rooms where others had died. (9) Yes, but not so much as adults to infants. (Cleveland. City.)

23. Tuberculosis is of mixed origin — amyloid or albuminoid — due to imperfection in digestion and assimilation, to constitutional types and faulty air, food and hygienic accompaniments. Facts to justify any definite answers to these questions are not at hand. In tuberculosis in young children diagnosis is not clear nor history continuous. (Cleveland. City.)

28. (2) I answer "no" because there has not been any such disparity as to attract my attention to the matter. (3) No, which may be partially due to the fact that I have for many years prohibited the use of milk from city-fed cows. (4) No, because I have always advised the use of mixed milk. (9) No, but I believe it to be entirely possible. (Cleveland. City.)

29. (*a*) We should isolate tuberculous patients and subjects as much as possible. (*b*) Every tubercular subject should be reported to the health authorities. This is far more important than reporting typhoid fever. Doctors should report whether being treated or not. The people should be instructed as to its being contagious and taught prophylaxis. (*c*) Every tenement where a tuberculous patient resides should be carefully watched and before another family occupies the place it should be thoroughly renovated and perfectly cleansed. It seems to me that one of the greatest sources of contagion is being grossly neglected. (Cleveland. City.)

31. Cannot answer questions 2 and 9 definitely because of limited number of cases of tubercular disease in children. (4) Use a mixed milk, pasteurized in all cases. (Cleveland. City.)

32. I have observed a greater tendency to bowel trouble in infants fed from mixed milk than when from a single cow, but cannot say definitely that it was tubercular. (Cleveland. City.)

34. I have had no experience with tuberculosis in babies, unless wasting disease, commonly called marasmus, is tubercular. I have noticed that this disease is very much more frequent in bottle-fed babies. I wish we could have a regular inspection and test of cows, with destruction of those suffering from tuberculosis.

I would recompense the owner for the first five years; by that time cows free from disease would be worth enough more so that owners could afford to lose those diseased. After cows each have a certificate of health I would advise the milk from single cows for bottle-fed babies. I hope you will push experiments in this direction. I am interested in this subject both as a physician and as a stockman. (Medina. Both.)

36. I always have the milk boiled before using it for infants or sickness and generally use lime-water with it. (Westerville. Both.)

37. (2) I have seen very few bottle-fed infants. Most of them died of diarrhœa. (3) I know of no tubercular cows. (10) I know of cases communicated from young adults to their elders. (Bentonville. Country.)

39. Fortunately I have had but limited experience with bottle-fed infants. They are mostly fed on the breast here. (Radnor. Country.)

40. (2) Yes; in general they seem less able to resist disease. (4) No experience; I always direct infants to be fed from single cows. (6) Two cases. (8) One had. (9) In one case I had an infant to die with tuberculosis; since then, in the same house, three adults have died of the same disease. (Stoutsville. Country.)

42. Bottle-fed infants are often allowed to suck the empty bottle to the detriment of the child. They are also given too much milk at one time, hence its coagulation and compaction in the stomach, which is more detrimental than the first named habit. Many years ago I was requested by the Woolgrowers' Association of Harrison County, Ohio, to write an article on the diseases of sheep, and for that purpose made special investigations; one conclusion reached was that the disease called "lamb cholera" results from too large a supply of milk in the dam, with an insufficiency of salt. I found the milk compacted in the stomach, causing a whey-like substance to pass from the bowels, and I believed that the pressure on the heart from the compact mass in the stomach caused the spasms and death of the lamb. (5) Filthy dairies send filthy milk to patrons and there may be various kinds of bacilli in it. I have treated scrofulous patients, the disease resulting from filthy habits and eating raw pork. (St. Clairsville. City.)

43. (3) One child, nourished by milk from one dairy, supposed by myself and others to contain tuberculous cattle; not verified by tuberculin test. (5) Have not observed such cases but believe it is undoubtedly true that meat and milk are the two chief sources. (7) One case, that of a child nursed by a tuberculous wet-nurse. (Martin's Ferry. City.)

45. For a year or more past this section of country has been almost exempt from tuberculosis, while 3 or 4 years ago there were a number of cases. (Damascus. Country.)

50. In sixteen years' practice in this community I have never been able to trace a single case of tuberculosis to the milk supply. The cattle in this vicinity seem to be remarkably exempt from tuberculosis. (Forest. Country.)

55. (2) Most bottle-fed infants of the poorer classes die of acute indigestion, and do not live long enough to develop tubercular troubles. (3 and 4) Mixed milk is so generally used in the city that it is impossible to tell where any given sample comes from. (Cleveland. City.)

57. (3) I recall one case — a child who was fed on the milk from an apparently healthy cow. The babe died of phthisis, and a year or more after the cow became emaciated and died. (7) Yes, a visitor or another member of the family who had the disease. (Lancaster. Both.)

64. I tell my tuberculous patients to be very careful about the sputum — never to deposit on the floor, etc. I never want any one to sleep with one who has tuberculosis nor to be in company with such a one when it can be avoided. There is no doubt that the disease is communicated from person to person, and

the greatest care should be exercised about it, and everything as thoroughly disinfected after a case of it as after any other contagious disease. No one should be allowed to sell milk in towns until his herd is first examined and shown to be free from the disease. The sanitary condition of the stables, cows, and the people who milk the cows should be thoroughly investigated by some one competent to do that work and do it well, without fear or favor. (Urbana. Both.)

65. (3) Child one year old (boy) very much emaciated; looseness of bowels; medicine did but little good; advised to change milk; child recovered in short time and is to-day strong and well. Found cow unhealthy, confined in close stall and poorly fed. I have every reason to believe that the cow had tuberculosis. (Sevenmile. Country.)

66. In reply to your favor, would say, that a careful study of this subject for over 20 years leads me to the following conclusions: (*a*) Consumption is not hereditary in the general acceptance of the word. (*b*) It can only attack or gain foothold in those who are weakened — in other words where malnutrition exists. (*c*) While I admit the truth of the Koch theory, so far as the existence of a parasite is concerned, I do not believe it to be the primary cause of the disease, but the result of it, i. e. the person must be in condition to receive and without power to throw off their influence. (*d*) I believe it to be contagious when those who are in direct personal contact become enfeebled by exposure or otherwise to a weakening of their vital powers, and only then; malnutrition is the forerunner of consumption. (*e*) There is no doubt in my mind but that tuberculosis is communicated from cattle to man, but only to those whose systems are in condition to receive the germs. I take from my book the following points: From 100 cases, children 1–16 years, number of bottle-fed, 17; tubercular trouble in some form, 3; breast-fed, 19; tubercular trouble in some form, 1, with one case doubtful. Of the remaining 64, 2 percent had weak lungs, but have developed nothing as yet. It must be remembered that these cases were among a class who did not take the best care of themselves.

To sum up: I believe tubercular disease can be communicated by milk to those who are fit subjects for it, more than it can be by meat, unless eaten raw, and that if more attention was paid to our meat and milk, tubercular trouble would become quite rare in time. (Columbus. City.)

67. (5) I am of the opinion that this cause is very much overrated. (9) No, but I am positive that adults have communicated it to children, also to adults. I am pursuing investigations along this line at present. I consider the schools a source of contagion. (Columbus. City.)

76. The wife of M—— W—— died of tuberculosis, and after her death his sister went to keep house for him. In two years she died of tuberculosis. Her sister waited upon her, and appeared in good health for several years until she married J—— N——. The parents of M—— W—— then moved into his house, when his mother became sick with tuberculosis at the age of 70 years, and died in a short time. J—— N—— then moved into the same house and had lived there a year when his wife gave birth to a fine, healthy looking boy; but the mother rapidly developed tuberculosis and died, and in a month the babe developed a marked case of tubercular meningitis and died. These last two cases were waited upon by J—— N——'s sister, who became ill with tuberculosis within a year and died with the same dread disease. There was no previous tubercular trouble in the N—— family. (New Market. Country.)

77. (7) Yes, in five cases; the father in one, aunts in three others. (Ada. Both.)

78. I have seen but three or four cases of tubercular trouble in children. A child of 4 years, with pulmonary tuberculosis; a child of one year, with tuber-

cular hydrocephalos; a child of 21 months and one of only a few months with tubercular meningitis. In none of these was I able to trace the origin of the trouble to any cause satisfactory to myself. The last three cases were all bottle-fed, but there are children in each of these families fed in like manner from the same cows that have escaped that dread disease. I instruct my people as to the infectiousness or contagion of the disease, and warn them to be careful accordingly. (Sharonville. Country.)

80. (3) Yes, when cows were kept shut up in small stables and fed mash and slops. (4) Greater frequency in single cows, when city-kept. (5) Can give no particulars that are complete. (6) I know of only one instance. (7) An aunt. (Cleveland. City.)

81. (2) All cases of supposed tubercular meningitis except one or two were bottle-fed infants. (Van Buren. Country.)

85. I think No. 9 can be answered in this as in most other contagious diseases: adults do not contract from children as children do from adults. (Cincinnati. City.)

86. (9) No, because there are so many chances of contagion from adults that are tuberculous. (Columbus. City.)

92. (4) It has so happened that all the tubercular children that have come under my care came from tuberculous parents. (Lancaster. City.)

95. While I firmly believe in the infectious character of tuberculosis, I have never observed the disease following the use of milk but once, and heredity was so marked in that case that I doubt very much that milk was the cause. I still believe that heredity plays the largest part in the propagation of tuberculosis and question whether a person can be infected with the disease who has not inherited the tubercular diathesis, or acquired it by poor food and poor hygienic surroundings. (Wauseon. Country.)

98. (6) I have, in a number of cases. (7) Generally the father had tuberculosis. In all, or nearly all, my cases I could trace it to the father's side, or grandfather — not to meat or milk. (Ashley. Both.)

106. (6) The only cases I have noticed were when the mother was tuberculous. I have had infants taken from infected mothers and placed on the bottle with immediate improvement. Of course we select a healthy looking cow, and only allow that cow's milk to be fed to the infant. (Lyons. Country.)

107. I have had two cases where I thought the disease was communicated from one member of a family to another. I believe that if the instructions sent out by the Ohio State Board of Health (Dr. C. O. Probst, Secretary, Columbus, Ohio) were followed closely the deaths from tuberculosis would be very much diminished. (Fostoria. City.)

108. I believe in hereditary tendency and development by contact. I have observed communication from one adult to another. (Newark. Both.)

109. In the majority of cases it can be traced to contagion. (Norwalk. City.)

110. I have never practiced where there are large dairies, and no cattle in this vicinity have been suspected of being tuberculous. (Georgetown. Both.)

111. There was tubercular disease in my wife's family, although she died of pneumonia. My children were raised by the bottle, yet they and my grandchildren are very healthy. (Fredericktown. Both.)

114. My practice is almost entirely in the country, with very few cases of tubercular disease, and those chiefly in adults. We have no large herds of cattle, and comparatively very few bottle-fed infants. I am fully satisfied of the communicability of the disease from individual to individual, from instances within my knowledge. (Webster. Country.)

115. Practice exclusively in the country. Have had no experience with infantile tubercular disease. (Hepburn. Country.)

120. (7) I do not believe tuberculosis to be contagious. In 50 years' practice of medicine I have seen several families where the mother died with consumption after having had five or six children; they living to maturity without showing any signs of it. Some of the mothers had it when pregnant. I have known of persons dying from it when not a trace of the disease could be traced in the most distant relative. In one instance the father died from it; three of his sons died from it about maturity, but none of the daughters ever had it. In other instances the husband or wife died from it, the one left never taking it. I believe there may be a predisposition in some persons to take the disease from neglected colds. (Gibsons. Country.)

123. (2) Yes, but most of them die the first year from indigestion. (5) I have not known of any bovine tuberculosis in this (Darke) county in 27 years. (6) Not to be sure of. We have no autopsies in this county. (New Weston. Country.)

124. (2) No, unless acute indigestion and meningeal affections are tubercular in origin. (4) Those fed with mixed milk were much more liable to the above affections than those fed from milk of selected single cows. (Leesburg. Country.)

125. (5) Yes, in cases where parents and relatives were healthy and no tuberculous visitors or attendants could account for it. (Elyria. Both.)

128. Mr. E—— died, so I was told, of consumption of the lungs. Mrs. E—— gave birth to a child near the time of the father's death. About ten or twelve months after the birth I was called to treat the child. There was cough, emaciation and other tubercular symptoms. After a continuous treatment for some eighteen months or longer it became a hearty boy and now, at 4½ years, is quite hearty. There is no history of tuberculosis in the family of which Mrs. E—— is a member, and the only way I could account for the little one's malady was, that it was phthisis, derived from the father and not from the nursed mother, who shows no signs of having any dyscrasy. We have few bottle-fed infants here; probably not one in fifty. (Addison. Country.)

129. Thirty years' country practice leads me to think there are very few such cases in a healthy country, where the water is good. (Delta. Country.)

131. (5) I have had no reason to suspect it in any particular case but I believe it often occurs. (7) I have observed cases in adults contracted from a tuberculous attendant. (8) I have observed a number of cases in infants and adults in houses previously occupied by tuberculous persons. (Cincinnati. City.)

134. I believe that milk and meat are carriers of the germs, notwithstanding that I have been unable to identify them as causes in any one case. (Huntington. Country.)

137. I have believed for over thirty years that tuberculosis was infectious, and the child is more liable to be infected from a tuberculous mother's breath or a kiss than from her milk. (Shiloh. Both.)

138. I have never heard of cows in this locality being troubled with tubercular tendency as they seem to be in some places. (Greenspring. Country.)

142. I have seen three cases of tuberculosis in infants (bottle-fed) whose mothers died of tuberculosis. One died before the mother, with pulmonary tuberculosis; one three months after the mother, with tubercular meningitis and the third recovered after its mother's death and upon changing homes. This, of course, does not touch upon bovine infection. I am at present physician to the Shelby County Children's Home, and have been impressed with the small amount of infection at this and other homes. (Sidney. City.)

143. (5) Yes, in the case of the mother having a tubercular diathesis. (7) In one case. In another there was probable heredity. (Rushsylvania. Country.)

146. I live in a neighborhood where there is but little tuberculosis, especially among children. I have in mind one case, an infant which died from tuberculosis,

having taken it from the mother, (she died about two months before the child) and in all the other cases which I have waited upon, as far as I could tell, heredity played an important part. (Stevideo. Country.)

148. In a practice of ten years I have never had a case of infantile tuberculosis. (Union Furnace. Country.)

149. (4) I prefer mixed milk of large herds and always have the milk well sterilized. (5) I think not; heredity or some acute disease seems to precede infection, although in some cases no predisposing cause was apparent. (7–8) Cannot say, but as a rule the surroundings were not as healthy as they should be. (9) No. I think the reason for this is that children do not expectorate and are less liable to the pulmonary form of tuberculosis. (Cleveland. City.)

153. (2) While I have never had a bottle-fed infant develop tuberculosis, I believe that generally they are more fit subjects for its development than the average breast-fed infant. I have noticed that infants throve or the reverse, in proportion to the manner in which the milk is prepared. In intelligent families, where care is taken, usually a bottle-fed infant does as well as a breast-fed one; but when the milk is carelessly prepared the child does not do well. (5) While I have never been able to trace tuberculosis in bottle-fed infants to the milk supply, I believe it to be a source of the disease. (Columbus. City.)

155. (9) Yes, the same bacillus is present, and affects the predisposed, young and old alike. (Steubenville. City.)

156. I had a patient last spring; married lady; no children; no tuberculosis on either side of family, who contracted the disease by dressing, laying out and removing bedding of a neighbor lady that died of tuberculosis. She carried out the sodden bed ticks and bedding right in front of her face. I did not attend the lady who died first. Neighbors say she expectorated over bed and floor. In the second case the diagnosis was confirmed by post-mortem. (Rushville. Country.)

159. (2) I am satisfied that more than once I have seen bottle-fed children sick with tubercular disease, but I never saw a tuberculous child breast-fed by a healthy mother. (3) I recall two or three cases in which I had reason to suspect the milk supply, but cannot give definite particulars. (4) I have noticed that children fed from one cow only are more apt to be sick than when fed from several cows. (5) I never noticed tuberculosis in children as caused by the meat supply, but rather from lack of meat; I am convinced that tuberculosis is a contagious disease, to a considerable extent. I have had some practice among the negroes, and they are notorious disseminators of tuberculosis. (Beaver. Country.)

161. In this blue grass region I have been in favor of bottle-feeding, because of the possibility of procuring milk from healthy cows; but have advised keeping away from herds and from cows closely stabled, for winter use. (London. City.)

162. My active practice ceased eleven years ago, before the recent investigations as to tubercle bacillus. Experience taught me that bottle-fed infants, under old methods, were more liable to tubercular affections, especially tubercular meningitis and scrofula. (Chillicothe.)

164. I believe the disease is contagious, not inherited, and that a house occupied by a tuberculous person is a source of contagion to younger persons. (Toledo. Both.)

165. I can recall but one case of pulmonary tuberculosis in an infant. This was breast-fed and since the child's death several aunts have died with tuberculosis. I have seen some 10 or 15 infants die from tubercular meningitis, when they were breast-fed, but can give no information as to antecedents or house in which they lived. One family living in a brick house had the mother to die of tuberculosis. No precautions were taken as to sputum. A daughter died some two years later

of the same disease. Immediately after the second death I had the entire house disinfected with formaldehide. This was three years ago. The husband and two children are in perfect health at this time. I have seen no case of bovine tuberculosis, nor of human tuberculosis contracted from this source. My attention, however, has not been especially directed to this form of investigation in case of my patients. (New Paris. Both.)

166. (2) Too many do not live long enough to develop tubercular disease. (5) City pork-eaters are more prone to tubercular disease than those who abstain. (Zanesville. City.)

178. There seems to be little or no tubercular disease in this section. (West Carrollton. Country.)

185. We have a family that presents quite an interesting history, which is as follows: The parents have always been strong people and are living. They had ten children, all stout and hearty. The eldest child (daughter) married and went from home, and has never shown any tendency to tubercular disease. The next in age (son) married and within a year from day of marriage the wife began to show signs of tubercular lung trouble. She gave birth to a babe, grew steadily worse and died. Within two years the husband and babe were dead with tuberculosis of the lungs. The disease has continued its work in the family until now there remain four out of a family of ten children. They have all died between the ages of 18 and 28 years except the above mentioned babe, which was less than two years old. The eldest and the youngest three children are in poor health. It is probable that the others contracted the disease from the son's wife, which he brought into the family. (Crisp. Country.)

186. I believe that a large percentage of tubercular trouble in infants may be traced to the milk supply of artificially fed infants. I congratulate you on the work you are doing, and hope you may be able to point out clearly to the profession their duty in observing more closely the results of feeding infants from cow's milk. (Mansfield. City.)

188. I have become so thoroughly convinced of the danger to infants from feeding cow's milk that I invariably insist on the use of some other food, preferably malted milk. (Mason. Country.)

190. Regarding question 8: Almost directly opposite my house stands an old dwelling in which two deaths from consumption have occurred since 1873. It has been occupied by several families (renters) several years since the deaths took place. No efforts at disinfection were made. Healthy children have been born and reared in it without the slightest indication of infection to any of its occupants, old or young, so far as tuberculosis goes. I know another house in this village which was used as a dwelling by a family consisting of father, mother and four sons; the father was of tubercular stock; he died of the disease as did the four boys. The mother who lived four years in an atmosphere saturated with the sputa, etc., stands alone to-day, probably because she was not cursed with the same evil inheritance. (Sugar Grove. Country.)

194. In a practice of 25 years I have seen but three cases of what might be called tuberculosis in children under two years of age. Two were tubercular meningitis and the other tabes mesenterica. All were from consumptive ancestry. I do not know whether they were fed from the bottle or the breast. My own experience is that tuberculosis is a very rare disease in infants. The only case of consumption in a grown person that I had reason to believe was propagated by contagion came from sleeping on a feather bed that had previously been slept on by a consumptive person. (McConnellsville. Both.)

195. Case 1: Child died of tubercular meningitis; father tuberculous. Case 2: Mother tuberculous, died when child was an infant. Child died at four years;

tubercular meningitis; bottle-fed, but have no knowledge of cause. Case 3: Child died of acute tuberculosis, following pneumonia; house a hot-bed of tuberculosis, several members of a family having died in it before this family moved into it. In my practice I have not had much experience with bottle-fed infants. (Qualey. Country.)

200. (5) A woman 40 years of age, who had been using the milk of a tuberculous cow, developed and died with tubercular peritonitis. (Louisville. Country.)

203. I have been a careful observer of tubercular troubles and conditions for the last thirty-five years. The position I occupy at the present time is more from what I have learned in treating and observing cases which finally terminated unmistakably in tubercular fatality than from anything I have ever read; and each day and each case gives me no good reason for changing my basis. If the vital force is perfect tubercular disease cannot be transmitted, either by contagion or by heredity; but if the vital force of any animal, including the human, is weakened in a certain relation to nutrition, tuberculosis will supervene, whether the parents have it or not or whether there be contact with any infectious substance. I am ready to accept much more than has ever been claimed for the tuberculin test and treatment, for it deals with conditions never accredited to its action on the living organism. The parasite is the product of, and not the cause of tubercular conditions or diseases. (Akron. Both.)

204. (3) No, and I believe the claims in this direction are grossly exaggerated. (5) No, or very doubtful; probably more meat than milk, and other diseases more often than tuberculosis. (9) No, nor as a rule is tuberculosis communicated from patient to other members of family. In 1900 cases less than 2 percent could be claimed as of this character. (Mt. Vernon. City.)

214. While my experience has not been of much value in determining that infected food is a source of danger, I firmly believe that it is. (Lebanon. City.)

217. (2) In this section there are very few bottle-fed infants. (5) Most cases are hereditary, with me. (9) Yes, because I believe the germ can be inhaled, and if the condition of the system is right for its reception and propagation tuberculosis will follow. (Mentor. Country.)

218. (2) No. More at breast. I have found marked cases of tabes mesenterica and one of tubercular abscess following the nursing a tubercular mother, in child 18 months of age. May the Ohio Agricultural Station push this good work. (Alliance. City.)

221. I have had several cases of tuberculosis under my charge but in no case have I been able to trace the disease to bovine origin. (Carey. Both.)

222. I have found children fed from herd milk subject to disease of the bowels, or tabes mesenterica. In my opinion tuberculosis is contagious only when the strictest sanitary measures are not carried out. The expectorations should be collected on cloths and burned and other sanitary measures should be observed. (Weston. Country.)

227. I regret that I cannot aid you in your laudable research, the facts are as you state but I cannot furnish the proofs. (Springfield. City.)

229. (2) No, only to gastro-intestinal trouble. (8) I have found several houses to have successive tenants become tuberculous. (Marietta. City.)

230. (5) Some cases do occur in families apparently not tuberculous. (Akron. City.)

231. (9) Only one instance in fifty-two years. (Tiffin. City.)

237. (2) They are more subject to stomach and bowel troubles, but whether to tubercular disease I do not know. (Lemoyne. Country.)

238. (3) One suspected case of tubercular meningitis, but was unable to confirm by autopsy. Child nearly two years old. (Cheshire. Country.)

240. While I find but little opportunity to trace out the causes of tuberculosis I find that it is most prevalent in houses that have been long inhabited in older parts of town. All the evidence seems to me to indicate that tuberculosis is contracted by contagion or by consumption of infected food, and not by heredity. Nothing seems more reasonable to me than that milk from tubercular cows would transmit the disease to children. The inspection of cows with regard to tuberculosis would be hailed with approval by the medical profession. (Springfield. City.)

244. (2) Have had no cases in children when it was possible to tell that the bowel lesions were tubercular. (6) I have never seen tuberculosis in a child at the breast, although I can recall several cases of children who must have died of meningitis, most likely tubercular, and whose mothers afterward died of pulmonary tuberculosis. (Cincinnati. City.)

246. My practice is entirely in the country. The number of bottle-fed infants is very small. I cannot now recall a single case of infantile tuberculosis that could not be traced to hereditary taint from one or both parents or grandparents. (Beverly. Country.)

247. I have practiced medicine for 38 years, and during that time I have never seen a case of tuberculosis in an infant that was not the offspring of a consumptive parent, either father, mother or grandparent. I have frequently seen cases of bowel complaints, diarrhœa, etc., in bottle-fed infants that were plainly the effects of malnutrition and indigestion. From my experience I have no faith in diseases being contracted from the food except in typhoid fever, cholera and a few others, and then only when the stomach is "out of tune," or off its guard. — As boiled milk is easier digested than raw, it would be a good plan, in my opinion, to recommend that all milk intended for food for children should be boiled. I do not believe that tuberculosis is inherited, but I believe that the disposition towards the disease is inherited. (Clarington. Country.)

250. (2) Yes, much more. I have many times been obliged to get milk from another cow and sometimes to dispense with the cow altogether; but such cases usually arise from inanition or lack of ability to assimilate. (So. Bloomfield. Country.)

251. I feel that the answers I have given to your questions need a little explanation. — My practice is confined to three islands, Put-in-Bay, Middle and North Bass. The farmers here (for it is a country practice) are all small-fruit farmers. Very few keep more than one cow and, generally speaking, she has the very best care, clean and wholesome food and a clean and well ventilated stall to be kept in at night. Keeping but one cow they endeavor to have a good one, usually a half or three-quarter-blood Jersey, so you see when I am compelled to feed babies cow's milk, I have what very few physicians have, and I have always appreciated it, and think it has modified my answers to you very much. My tubercular cases have, so far, had a tubercular history of two or more generations. (9) A babe's mother, grandmother and great-grandmother, according to the best history of the cases I could get, had all died from consumption. The father, a perfectly healthy man and with no tubercular history for three generations, at least, would allow no one to nurse the child but himself. I was utterly unable to make him believe that he could contract the disease from his child. He nursed the child about 17 months when it died. During this time he developed a cough and it was followed by the usual symptoms, and about one year later he died with acute tuberculosis. So you can see surroundings shade my answers. (Put-in-Bay. Country.)

252. (6) In one case, and in that case the mother was of lymphatic temperament. (9) I have never found such a case, yet I am confident it might happen.

I believe that consumption may be inherited and that it is also contagious. (Rural Dale. Country.)

253. (6) Yes, two cases. (7) In one case, yes; the other had family history of tubercle. (8) I have had several "coincidences" of this kind and believe in rigid disinfection of such houses. (9) Never saw a case that could be traced; the reverse has fallen under my observation.

254. (4) All cases noted fed from single cows. (7) There were also in some cases tuberculosis attendants and visitors. (Lebanon. Both.)

261. (2) I have not, although they are more subject to many diseases, and tuberculosis of intestines may have been overlooked. (5) No, though I admit that such origin is probable. Often, too, the disease may come from tuberculous persons handling milk and butter. I believe that all are exposed to tuberculosis; that it is a question of susceptibility. With half the human race infected to some degree there is hardly complete escape from its contagion; yet it should be controlled in every way possible. (New Lexington. Both.)

263. There is only one family in my neighborhood in which tubercular disease has developed. The family is German; father healthy, 68 years of age; no signs of the disease in his family. Mother died at age of 52, from cancer of the womb. One boy died at insane hospital — tuberculous; two boys died at home, pronounced cases; one boy hung himself; there was no doubt but that he was slightly deranged; post-mortem showed right lung somewhat affected; two girls, married, died at home, clear cases of tuberculosis; two girls are still at home but are not strong. One girl is married; the first child, a boy, nursed, is not healthy. No tubercular disease on father's side. I ordered the next child (girl) to be fed from a selected cow, never permitting it to be nursed. It is now 13 months old, strong and healthy, and has not the sickly appearance of the boy. (Harris. Country.)

264. (4) I have had two cases where I believed that infants had been infected by changing from milk of single cows to that of herds. (6) I have observed four cases in which children had tubercular diseases while the mothers remained uninfected for years and are still healthy. (7) In these cases the father or some one else was tuberculous. (9) In one case I believe it was communicated in that manner. (Paulding. Both.)

265. Owing to the inadequate facilities for making bacteriological observations in the country it is impossible to make correct answers to most of these questions; but it is my opinion, supported by a limited experience, that the vast majority of tubercular infections occur from contaminated public houses and residences. Direct infection from ulcer to healthy abraded surfaces occurs easily and frequently; and if the cause of bovine tuberculosis is the precise bacillus of the human variety there is no reason why milk from a tubercular udder ought not to produce tubercular enteritis in the user. To the end that the statistics be trustworthy I would suggest that an effort be made to establish state bacteriological laboratories at convenient intervals over the state for the elucidation of just such problems. (Newton Falls. Country.)

266. I have just lost a patient (young man) from consumption. He was sick five months, passing into my care three weeks before death. During my attendance on him I became aware that the expectorations were emptied into the garbage barrel, where they were taken to be fed to cows and hogs by the public garbage collector. (Toledo. City.)

269. Believing tuberculosis to be contagious we are at all times and in all cases on our guard against sources of contagion and we do not average one case of tuberculosis a year in this thickly populated township. (Bellbrook. Country.)

271. (2) Bottle-fed children are more subject to all diseases than those

nourished at the breast by a healthy woman. (3) I believe so, but cannot give particulars. (4) My preference has been for mixed milk of large herds, as being more constant in composition. (5) I believe that tuberculosis may be due to milk or meat supply, but have not been able to demonstrate the connection. (9) I have seen no positive demonstration, but believe it possible. (Cincinnati. City.)

272. (3) I have had five or six tuberculous children that were fed on cow's milk and I could see no other cause for the disease, but no examination of the milk was made. (9) Yes, several such cases. (Columbus. City.)

275. My practice of 25 years has been favored by not coming in contact with cases such as you refer to. (Colebrook. Country.)

276. Nearly all the cases of tuberculosis in a practice of 30 years have been young unmarried persons. It is notorious that farmers drink less milk than people living in villages and cities. (Norwich. Both.)

282. In my experience the bottle-fed infants which die usually die of cholera infantum (acute) or of inanition from gastro-intestinal catarrh, due to overfeeding. I never had a case of tubercular trouble in an infant in which the tendency was not traceable to heredity. (Leipsic. Country.)

284. (2) There are relatively fewer bottle-fed infants in the country than in the city. It has been my experience that children fed on the bottle are more susceptible to tuberculosis than breast-fed children, but whether because they contract the disease from the milk or are less able to resist the virus I am not able to say positively. (5) It has been my opinion that some older children and adults contract the disease from meat, but more from contagion. (6) I have observed three cases of this disease in infants when parents were free and had no family history of tuberculosis. (7) I attributed the cause of two cases to a visiting relative who was in the habit of kissing both children frequently. (Peninsula. Country.)

285. I have not had a case of tuberculosis in a young child in 7 years' practice. (Kimbolton. Country.)

287. (4) When milk has been changed often or taken from different cows the greatest changes were noticed and the mortality increased. (Waterville. Country.)

289. I have had two infants which were never, to my knowledge, surrounded by tubercular people, but who certainly had tubercular enteritis, and I inferred that it was due to ingesting diseased milk; yet the cows appeared to be healthy. I have had two boys and one girl, in different families, no relationship, aged from 6 to 12 years, develop coxalgia (tubercular ostitis), yet there was no tubercular family history, as far back as we could reach. In all three of these families the cows did not have the best of care; their hair looked rough and dull in color, showing that they were not well nourished at least, and from appearances I inferred that they might have been the cause of the trouble. However, it is my conviction that children often contract this most dreadful disease, in some form, in the school room. (Quaker City. Country.)

291. My father inherited consumption from his mother and his children have all died with it except one brother, who has it, and myself. My wife's mother and two other members of her family have died with it. Our two children were raised on Jersey milk from fresh cows, well and carefully fed, the milk at first being diluted one-third with water and sweetened with milk sugar. These children at 18 and 12 years of age are hale and hearty and show no tendency to tuberculosis, so that my experience has been that milk properly prepared will not injure children but greatly benefit them. That tuberculosis is hereditary there can be no doubt, for it has been fully demonstrated. So far as contagion is concerned I think the only danger would be by inoculation, in some way coming in contact with the tuberculous matter. (Tiffin. City.)

299. I have had two decided cases of communication from adult to adult, but in 20 years' practice have had no case of tuberculosis under 15 years of age. I have had a few bottle-fed infants, but used prepared food chiefly. (Rogers. Country.)

301. (3) Not positively. Cases of pre-phthisis are more common in milk drinkers. (5) Meningitis; boy, 14; farmer; used meat and milk; no other probable source; fatal; several similar. Hip joint, intestinal and pulmonary tuberculosis and kidney tuberculosis observed in adults and children in healthy country homes without other apparent cause. Pre-phthisis is very common, more so among milk drinkers and meat eaters I think. (Tallmadge. Country.)

304. (3 and 5) Theoretically I believe tuberculosis can be communicated in that way, but I have met with no instance of the kind; in every case of tuberculosis in bottle-fed infants I have been called upon to treat I found evidence to convince me that the disease had been communicated from another person. (6) Yes; three instances, in all of which I believe the infants contracted the disease from their fathers who had it. (8) I have had one case of tuberculosis in adult where there had been the death of a consumptive in the same house about two years and a half before. Another case came under my notice — a servant girl who acquired the disease while working for a lady who had it in its last stage. (Dowling. Both.)

306. In this vicinity there have been no large herds of cows until the last six years, and the milk from them goes to the creameries. J—— H—— died with consumption of the lungs, but his wife and child show no signs of it, fifteen years after his death. (Croton. Country.)

315. We have very little tubercular trouble among children. (Marathon. Country.)

317. (3) A child 17 months old when I first saw him; had been fed on cow's milk; child rickety; tubercular; no hereditary tendency; second child; parents and brother healthy; believe it to be due to tubercular milk. (Cleveland. City.)

318. I have one case of pulmonary disease in young woman, supposed to have been contracted from a pet cat. (Zanesville. Both.)

319. (2) Yes, but a sick mother is a frequent cause for bottle feeding. (5) I have suspected it but could not demonstrate it. (7) Probably, as such persons, not being able to work much, are often general and frequent visitors. (9) Yes, and from adults to infants. Communication is, in my opinion, a larger factor than inheritance. (Ridgeway. Country.)

322. (2) No; less, if such bottle-fed infants have their milk sterilized by heat. (6) In one instance, where the grandmother was tuberculous and was much with the infant. (8) Impossible to determine, usually, as tuberculosis often exists without suspicion or proof. (Cleveland. City.)

324. (5) I have never considered it worth while to attempt any investigations, because we do not know a tuberculous cow from a perfectly healthy one without the tuberculin test. (West Jefferson. Country.)

325. (2) Yes, provided mothers are non-tuberculous. (3) Not directly, but milk from such cows is necessarily a pre-disposing cause. (5) No, partly because as country children grow older they drink less milk. (6) No, except where father was tuberculous. While there is, no doubt, direct tubercular contagion through the medium of milk of diseased cows, the number of cases in children must be small, compared to those that develop tuberculosis while being poorly nourished on exclusive use of milk from old and underfed cows, and especially those that have not been fresh for a year or more. In rare instances I have known cows too old to breed to be milked for a period of 2 or 3 years. Milk from such, like mother's milk after the first year of nursing, is exceedingly

poor in quality and may be a powerful predisposing cause of tuberculosis. Milk from diseased mammary glands of the mother, or udder of the cow, is an important factor in the induction of tuberculosis, often overlooked. How many large herds of cows can be found in which none can be found that give occasionally "ropy" milk? Such milk will surely induce malnutrition — a constant factor in all tubercular diseases. I never allow a child to nurse a breast that has at any time been abscessed if I can prevent it, but many a child receives milk from udders, the former seat of abscess. Such milk, if well boiled (not pasteurized) might produce a toxic effect, but never infection. All dairies should be inspected, whether or not the cows are "tested," as it would weed out the old and infirm animals. (Washington C. H. Country.)

327. (2) I believe it is seldom that the death of a child from tubercular disease is observed in the country, but we know that among bottle-fed infants there is greater mortality, due to deranged digestion, than among those who are nursed by the mother. (West Farmington. Country.)

328. (9) More from adults to infants, and some very plain cases of this; also some clear cases from one adult to another and some almost certain cases from vaccination. (Middlefield. Country.)

329. My practice of seven years has been confined to this one community and I have found but one case of infantile tuberculosis, that being as nearly hereditary as the disease can be. The adult cases have also had hereditary predisposition. (So. Lebanon. Country.)

330. My practice is entirely in the country and in the eleven years that I have been here I have met but three cases of tuberculosis, all adults, 25 to 40 years of age. One came here in an advanced stage and died here; the others I sent to Colorado and New Mexico and reports from both are favorable. It has not been possible to trace the disease to its origin in either case. (Kinsman. Country.)

331. There are very few cases of tubercular disease here. I have known of but three or four cases in five years. (Perry. Country.)

332. (4) In an observation extending over forty years I have never known a case of tuberculosis, the origin of which could not be traced to other causes than those named. (7) I have known the attendant to become a victim to tuberculosis. (Emery. Country.)

333. (3) Yes, in two cases we believe without doubt. (5) Yes, in both. (8) Not that we could establish. (9) In one case we could trace the disease to no other source. (Milford. Both.)

334. (2) No, because I always feed sterilized milk. (5) I have not had a case that I could trace definitely to either of these causes. (6) I do not think I have, but would not be certain. (7) When probably the father only was infected. (8) I have seen a case in an adult which I believed to have had this origin. (9) No, but believe that it might readily happen. I have seen three cases of pulmonary tuberculosis follow in rapid succession in the same family. (Madisonville. City.)

338. In treating children with tubercular mothers I have always fed some of the prepared foods or sterilized milk. I have lost a few tubercular babies in hereditary cases only. (Cleveland. City.)

339. My practice has been principally among the farmers of Champaign, Logan and Union counties, for forty-two years. I do not remember a single case of tubercular disease among children that I could reasonably attribute to milk or meat supply. I have always looked upon good, fresh, country milk as an ideal food for babies when there was any reason for the mother not nourishing them. Two children in one family contracted tuberculosis of lungs by sleeping with a tuberculous friend and visitor to the family. No other member of the

family ever developed the disease. In one case a young girl of non-tuberculous family developed the disease within three months after moving into a house where two persons had died within a year, in the room occupied by my patient.

As was to be expected the answers to our inquiries show a wide diversity of experience, representing, as they do, all conditions of life, from those found in the most sparsely settled country districts to those in our largest cities; and in considering the results we must bear in mind that the very nature of the case precludes the possibility of absolute demonstration. As was said in the preliminary bulletin, accompanying this circular of inquiry:

"The agricultural experiment stations, which are now world-wide in their operations, are pushing this investigation from the biological and veterinary sides; but there remains a field which neither the biologist nor the veterinarian can exploit — the field of human experience. We cannot take infants and children and experiment on them as we do on guinea pigs and calves, nor can we get under personal observation a sufficient number of the accidental experiments which humanity is blindly making to settle definitely the points in question. These experiments are being made every day under the very eyes of the ten thousand physicians in Ohio, and they, by taking up the third side of the problem, in the light which never before the present decade has shone upon it, may round out and complete the work; but without such help it cannot be done."

This appeal was made with great hesitancy, for it has been my observation that our physicians are the hardest worked, and often the most inadequately paid members of the community. Under the circumstances existing it was not possible to furnish even so much as the return postage for the information asked, the only compensation that could be offered being the possible value to the community at large of the results of the inquiry. Under these circumstances a special acknowledgment is due to the large number of physicians who have so kindly replied to the inquiry.

It will be observed that the country practitioners make frequent reference to the comparative fewness of bottle-fed infants in the country and also to the rarity of tubercular disease among country infants, several stating that they have never seen any cases of infantile tuberculosis in the country. The veterinarians make similar reports respecting the prevalence of bovine tuberculosis in the country. With occasional exceptions it is practically unknown, except in the vicinity of the larger cities. But the statistics show that there are more deaths in Ohio from tubercular diseases in infants under one year of age than at any other age-year of life, and since so few of these are found in the country we must conclude that the great majority of these cases occur in the cities, a conclusion which is confirmed by the statistics of the census.

Of course it does not necessarily follow that the excess of infantile tuberculosis in cities is altogether due to the larger proportion there of bottle-fed infants, nor to the greater prevalence of bovine tuberculosis in

the dairies from which much of the food of these infants is drawn. The statistics show that the deaths from tubercular disease at all ages are relatively more numerous in the city than in the country. How much of this excess in cities is due to contaminated food supply, and how much to greater exposure to other sources of infection, cannot be known, but the fact that tuberculosis of children has been traced so directly to tuberculous milk, fully justifies the inference that such milk may be an important factor in the infantile death rate of cities.

Both classes of physicians agree that there is no food for the babe so wholesome as that from the breast of a healthy mother, and there is also a general agreement that the bottle is the safer source of food supply if the mother be tuberculous.

While comparatively few report that they have been able to trace the origin of tubercular disease, either in infants or older persons, to the meat or milk of tuberculous animals, yet there are enough of such reports to justify all the vigilance that can be exercised to avoid such infection. In considering this point we must remember the exceeding slowness with which tubercular infection often, if not usually, takes place, in consequence of which it would, in most cases, be practically impossible to trace such infection to its exact source, even if the most extreme views were accepted regarding the danger of infection from the food supply. This is especially true of the cities, where so little is or can be known of the sources of such supply. Our experiments are fully corroborative of thousands of others in showing that an animal may be infected with tubercular disease for many months before any external symptoms become manifest, and we have no reason to doubt that the same is true of the human subject. For this reason, the source of infection would, in most cases, be completely lost sight of long before its symptoms became manifest.

The answers to the fourth question are largely colored by circumstances. Only the wealthy family can keep a single cow under normal conditions in the city, while the attempt to procure the milk from such a cow kept outside the city must be attended with much uncertainty; hence the city practitioner rightly prefers mixed milk; but in the country there are few large herds, and the farmer has the best opportunity for selecting and caring for a single cow in such manner as to attain the best results, a point well brought out in reply No. 251, and so we find that physicians in the country very generally prefer the milk from single cows, although there are exceptions in both cases.

THE HEREDITY OF TUBERCULOSIS.

Questions 6, 7 and 8 were designed to bring out observations bearing upon the problems of heredity and contagion or infection in tubercular disease, and the answers given are worthy of the most careful study. Of those who have observed instances of tubercular disease in infants breast-

fed by tubercular mothers, many add remarks indicating that they are very unusual. "One case", "one or two cases", "a few cases", are expressions recurring repeatedly in their reports. Some of those who reply to questions 7 and 8 in the negative add remarks indicating disbelief in the contagiousness of the disease, while many of the doubtful replies show that attention had not previously been drawn to those possible sources of infection.

When we consider these replies in connection with the statements of many of the physicians having country practice, that they have met few or no cases of infantile tuberculosis of any sort, even in a practice of many years, we must conclude that *infantile tuberculosis is an extremely rare disease, except where there is a tuberculous environment.* This is a most important point. We have been assuming that because the children of tuberculous parents are so often tuberculous, therefore tuberculosis is a hereditary disease; but we would not think of calling measles and smallpox hereditary diseases on the same kind of evidence.

The fact that entire families are swept away by this scourge, and that it reappears in generation after generation of the same blood, are quite as easily explained by the theory of contagion and infection as by that of heredity. Under no possible conditions could the opportunity for communication of disease from person to person, and especially from parent to child, be greater than under those of the family, especially when watchfulness against such communication has been relaxed because of belief that the disease is only hereditary and never contagious. And when we consider the insidious onset and the slow course of the disease, and the great length of time through which the germs of other diseases are known to retain their vitality, we can readily understand how tuberculosis may pass from generation to generation, and how infected houses may carry the infection to later tenants, perhaps of the same family, perhaps of others; perhaps those immediately following, perhaps not until years afterward, when some long undisturbed deposit of infectious matter has been freshly stirred up.

The cases in which members of a family escape the infection, while others fall victims to it under apparently no greater exposure, are paralled by similar cases of immunity in all contagious diseases, both among men and animals. Some individuals appear to be immune to certain diseases throughout life, while others escape at one period of life only to be taken at another. In fact, all experience indicates that the healthy human system will generally resist the tubercular infection until way has been made for it by some other disease. A severe cold, for instance, may leave a plowed and harrowed field in the pharyngeal or bronchial glands, in which the germs of the tubercle bacillus find a congenial lodging place.

In short it would seem much easier to formulate a cohesive and rational theory of the propagation of tubercular disease by infection than to account for it by heredity; and while I would not be understood as deny-

ing the possibility of a hereditary tendency, making the individual more liable to the tubercular infection, it does not seem that such a theory is at all necessary to account for the phenomena exhibited by tuberculosis, if we but take into consideration all the factors bearing upon the problem.

In discussing the question of heredity we should keep clearly in mind the biological meaning of the term. The fact that the child of tuberculous parents develops tuberculosis, is by no means conclusive evidence that it has inherited the disease in the sense that it may have inherited physical conformation or mental characteristics. The experience at this Station with tuberculosis in swine, given on another page, gives a forcible illustration of the manner in which the disease may even skip a generation, to reappear in full force in the next and yet not come under the law of heredity, as above defined. Again, there is a possibility of pre-natal infection from either parent, previously referred to, which would be quite a different matter from constitutional heredity.

It is true that either of these forms of transmission of the disease given would be in one sense a hereditary transmission, but it would be transmission of infective material, not of actual disease nor of diathesis. The difference may at first sight appear to be one of hair-splitting; but in fact this difference is of fundamental importance, because there can be no hope of overcoming this dread scourge until the fatalistic idea that it is a constitutional disease can be displaced by a clear conception of its contagious character.

It is the province of the agricultural experiment station to learn and demonstrate facts, rather than to formulate theories, and to deal with questions pertaining to agriculture, rather than those of general hygiene. The study of the diseases of animals, however, is explicitly enjoined upon these stations, and the problem of tuberculosis in animals is so intricate, and withal so closely interwoven with that of the same disease in the human subject, that all the light is needed that can be obtained by the joint study of the disease in both classes of subjects.

It is safe to say that in the experiment stations, and among those who have had the widest opportunity for studying tuberculosis in animals, there is no longer a shadow of doubt as to its contagious character; and that if the war against this disease is to be successfully waged it must be along this line. Therefore it is of first importance that the farmer and cattle breeder should be shown the grounds upon which this belief in contagion is based, and should have their eyes opened to the possible explanation of human tubercular disease on the same grounds.

On one point we may be sure, whether dealing with animals or men, and that is that we can be led into no fatal or injurious mistake by accepting and strictly acting upon the theory of contagion. The destruction of the sputa of the consumptive, the utmost cleanliness in rooms and clothing, the avoidance of every possible means by which the disease may be com-

municated can do no harm in the case of the human subject, and abundant evidence has been accumulated to show that it may do much good.

In comparing the contagion of tuberculosis with that of measles and smallpox I would not be understood as claiming equal facility of propagation. On the contrary, it is not believed that the tubercle bacillus is usually, if ever, carried by the breath, or that it ever floats in the air, except when temporarily stirred up, as in sweeping. In the examination of milk for this organism it is found most frequently in the slime of the separator and in the heavier parts of the milk, and but seldom in the cream, thus showing that its specific gravity is greater than that of milk. It is believed that the sputum is practically the only vehicle by which the infection is carried. It follows, therefore, that *with proper care* the consumptive is not necessarily a source of contagion.

Regarding infant mortality from tubercular disease some interesting statistics are given by G. Sims Woodhead, M. D., in the *Practitoner* for June, 1898, who quotes from investigations by Bolitz on the statistics of post mortem examinations of 2, 576 children, who died in Kiel during the years 1873-1889, and in whom were found the following percentages of tuberculosis to the total mortality at each of the different ages:

Sitll-born children..... ..	0.0 per cent.	Up to 2-3 years old.. .....33.0 per cent.	
Up to 4 weeks old	0.0 "	" " 3-4 " " ..... .29.6 "	
" " 5-10 weeks old.....	0.9 "	" " 4-5 " " .....31.8 "	
" " 3-5 months old	8.6 "	" " 5-10 " " .....34.3 "	
" " 6-12 " " 18.3	"	"10-15 " " .....30.1 "	
" " 1-2 years old.....26.8	"		

It appears from this table that there was no evidence found of tubercular disease among stillborn infants and those which died during the first weeks of life, but that the percentage of deaths from such disease was relatively uniform from the second year onward. These statistics are in harmony with our knowledge of tuberculosis in cattle, but they seem to be at variance with the statistics shown by the census and tabulated on page 344, in that they show a larger relative death rate from tubercular disease during childhood than is shown by our statistics. Three points must be considered here, however, namely: (1) European statistics and general statistics show that tubercular disease is much more prevalent in Europe than in America; (2) the statistics just given are those of a large city, whereas the population furnishing the statistics of our census was one-half rural, and the evidence shows that rural districts are relatively free from tubercular diseases, and (3) they are statistics derived from post mortem examination, whereas those of our census are chiefly made up from ante-mortem diagnosis only, and there is reason to believe that this is often defective, especially in those forms of tubercular disease to which children are especially subject. Says A. K. Chalmers, M. D., of Glasgow, in the journal just quoted:

"Indeed, every post-mortem room affords ample testimony that tuberculosis in children is more common than is usually supposed, and that many of the chronic diarrhœas and broncho-pneumonias are in reality of this character."

In this connection I quote from a report in the *Standard* the statement by Sir Richard Thorne, a member of the Royal Commission on tuberculosis, that whereas there has been an immense reduction in the death-rate from many forms of tuberculosis, notably phthisis, yet when we examine the death-rate from *Tabes mesenterica*, a form of tuberculosis in which the infection is received into the alimentary canal instead of the lungs, it is not only found that the gain attained at other ages has been lost in the case of children and infants, but that, in addition to this, there has been a very heavy increase of deaths from this cause, under one year of age. This increase, says the authority quoted, has gone hand in hand with a steady increase in the consumption of cow's milk as a food in England.

IS CONSUMPTION DECREASING?

Mortuary statistics of consumption indicate a decrease in the death rate from that disease during recent years, both in the United States and in several European countries, and this fact has been brought forward as an argument against the theory that bovine tuberculosis, which is apparently on the increase, is identical with human consumption. In this connection the following table, showing for Ohio, exclusive of Hamilton county,[30] the total number of deaths for each year since 1877, the number accredited to tubercular disease, to influenza and grippe, and to diseases of the respiratory system, may be of interest:

[30] The statistics of deaths in Hamilton county are regularly omitted from the State reports because of their gross inaccuracy.

TABLE XVI — DEATHS IN OHIO FROM TUBERCULOSIS, INFLUENZA AND DISEASES OF THE RESPIRATORY ORGANS.

Year ending March 31.	Total deaths from all causes.	Death from tuberculos disease.	Death from influenza and grippe.	Death from diseases of respiratory organs.	Percentage due to tuberculos disease.	Percentage due to tuberculosis and influenza.
1877	25,637	3,767	38	2,386	14.7	14.8
1878	22,662	3,156	27	2,005	13.6	13.7
1879	25,284	3,446	35	2,719	13.6	13.7
1880	24,477	3,366	17	2,210	13.7	13.8
1881	27,182	3,416	24	2,927	12.5	12.6
1882	27,944	4,111	48	2,046	14.7	14.9
1883	26,606	4,022	64	2,664	15.1	15.3
1884	24,364	3,929	84	2,162	16.1	16.5
1885	29,960	4,035	52	2,423	13.5	13.6
1886	28,133	4,140	59	2,090	14.7	14.9
1887	29,325	4,516	55	2,430	15.4	15.6
1888	31,630	4,522	71	2,917	14.3	14.5
1889	31,463	4,390	73	2,753	13.9	14.1
1890	32,440	4,240	1,046	3,183	14.	16.3
1891	34,333	4,177	1,367	4,165	12.2	16.1
1892	37,037	3,949	3,385	3,642	10.7	19.8
1893	32,983	3,672	767	3,092	11.2	13.5
1894	34,498	3,867	1,291	3,683	11.2	14.9
1895	36,225	3,918	987	3 901	10.8	13.5
1896	33,585	3,933	660	3,298	11.7	13.6

This table shows a close uniformity in the proportion of deaths from tubercular disease until the grippe appeared; since that date there has been a marked falling off in the percentage of deaths ascribed to tubercular disease, but when to these are added the deaths from influenza and grippe, the average percentage of deaths from the two classes of diseases combined has apparently undergone no change in the 20 years covered by these statistics; while if we add to these the deaths from other diseases of the respiratory organs (chiefly pneumonia) we find that there has been a marked increase in the total death rate from diseases affecting the lungs during the last seven years, the percentage of deaths ascribed to such diseases, in the deaths from all causes, being 23.4 for the thirteen years previous to the appearance of grippe, against 25.8 for the seven years following.

In the report of the New Jersey State Board of Health for 1898 is given a table (page 9) showing the deaths in New Jersey per 10,000 of population from classified diseases for the 20 years, 1879-98. From this table we find that the deaths in that state from consumption per 10,000 of population for the 11 years, 1879-89, averaged 25.85, while those from "acute lung diseases" averaged 19.88, those of the first class for every year exceeding those of the second. With 1890, however, the relative

proportion was suddenly reversed, and for the 9 years, 1890-98, the deaths averaged 21.37 for the first named class and 26.01 for the second, the number being invariably greater in the second class, while the total deaths from the two classes averaged 45.68 per 10,000 of population for the first 11 years and 47.38 for the last nine. These statistics, it will be seen, are in close harmony with those of Ohio.

Finally: The census reports of the United States show the following death rate per 100,000 of population in 1880 and 1890:

	Cause of death.	
	Consumption.	Respiratory diseases.
United States, 1880	182.3	215.1
United States, 1890	163.2	221.0
		Pneumonia.
England and Wales, 1880–'89	174.9	103.2
England and Wales, 1890	168.2	140.3
Ireland, 1880–'89	209.7	53.3
Ireland, 1890	215.7	70.3
Scotland, 1880–'89	201.7	104.0
Scotland, 1890	191.3	122.9

Except in Ireland, where both classes of diseases show an increase, these figures indicate a general falling off in consumption with a considerable increase in other forms of lung disease, this increase, on the whole, more than counterbalancing the apparent decrease of consumption. The statistics for Great Britain are quoted from the report of Dr. John S. Billings, special expert agent of the Eleventh Census of the United States.

The point suggested by all these statistics is that since the advent of the grippe many cases of incipient consumption have terminated in grippe or pneumonia and have been reported as such.

THE STATE CONTROL OF TUBERCULOSIS.

In several of the eastern states the attempt has been made to get control of this disease in cattle, but as yet these attempts have been only moderately successful. One of the most striking object lessons, showing how not to do it, has been furnished by the state of Massachusetts. In 1894 that state enacted a law providing for a general inspection of the cattle of the state, and for the testing with tuberculin of all cases in which tuberculosis was suspected and the destruction of all reacting animals. This law was afterwards so amended as to provide for full compensation to the owner for all animals killed as tuberculous, with certain reservations, and it seems to have been so loosely administered that compensation was allowed for animals killed as the result of private tests. A hint as to the actual outcome of such a law is given in the annual report for 1897, by the commission charged with its execution. They say:

"In many instances it is found that from some localities certain names appear upon our books more frequently than any other persons, seeming as though special individuals found it profitable to buy suspicious cows and sell to the state at an advance upon purchase price. Then, again, farmers last spring employed veterinarians to test cattle, with the idea, in many instances, of selling unprofitable cows to the state, and using the money to buy new ones that had not been over-grained and milked out.

"Further, local inspectors quarantine cows on suspicion that show no physical evidence of disease, which react to tuberculin, are killed and found to have slight lesion. The owner puts a new cow in place of the old one, that may not be free from tuberculosis, or, if she is, may in six months be diseased to the same extent (or more) as the old one, if he has neglected to disinfect the place where the old one stood, or has been careless about it."[31]

Under this system it seems that 24,685 cattle were tested in the 4 years, 1894-97, of which number 12,443, or 50 per cent, were condemned as tuberculous. For this work was paid, for the salaries and expenses of commissioners and agents, $123,061; for cattle killed, $494,543; and for other expenses, $107,342; a total of $714,966.[32]

Had the state been freed from bovine tuberculosis at this cost or at twice this cost the money would have been well spent; but the fact appears to be that, although there was a marked decrease in the number of cases of generalized tuberculosis, yet herds which were retested the last season, after having been cleaned out two years previously, and filled up since with tested cattle only, still showed a large percentage of tuberculous animals—in some cases a larger percentage than was found at the first test, the indications being that the disinfection of the barns had been neglected.

The laws of Ohio rightly forbid the offering for sale of unwholesome or adulterated food products; even so harmless an adulteration as the addition of pure water to milk is prohibited, while the exposure for sale of milk from diseased animals is forbidden under heavy penalties. The enforcement of these laws lies with municipalities, which have ample powers. These municipalities are vitally interested in securing a supply of pure food, and it is not only their right but their duty to see that the cows which furnish the milk sold on their streets shall show a clean bill of health, and that the meat exposed for sale within their limits shall have been taken from healthy animals.

It is probable that much more than half the cases of bovine tuberculosis in Ohio would be found in the large dairies supplying the cities and towns with milk. The rigid insistance by these municipalities that all cows furnishing milk to be sold on their streets should pass the tuberculin test; this test to be made only by duly authorized inspectors and to be repeated at least once each year, cows passing the test to be distinctly

[31] "Agriculture of Massachusetts," 1897. Report of Board of Cattle Commissioners, p. 492.

[32] Summary in American Agriculturist, 1898, p. 647.

tagged, those failing to pass to be immediately removed from the herd, would soon rid these dairies of the disease, and through them the cleaning out process would eventually reach practically the entire state. A herd once decimated by this test would only be filled up again with tested cows, and if the dairyman were his own insurer against loss from tuberculosis he would not permit his premises to remain infected with the germs of the disease.

This course would eventually clean out the disease from the state; for it would soon become impossible to sell cattle for either meat or dairy purposes which had not successfully passed the tuberculin test. In fact, this condition is already at hand with reference to pure bred cattle, as the breeders of such cattle are now subjecting their cattle to this test, because no well informed man will purchase an animal for breeding purposes which has not been thus tested.

The method of municipal control here suggested was adopted by Minneapolis in 1895, in a general law which does not order any cattle tested, but which merely says in substance—"If your cattle are not tested you cannot sell milk on our streets." No man can legally sell milk without a license, and a certificate of tuberculin test must be presented before a license may be granted. All cattle tested are tagged and numbered, and record is kept of all tests and of the disposition of the tested cattle.

The law has been confirmed by the supreme court of the state, the court holding that the city can require the inspection of a dairy herd from which milk is offered for sale within the city, although such herd may be kept outside the city limits, and also that the tuberculin test is not unreasonable.

The first enforcement of a regulation of this sort would involve hardship in the case of herds found infected with the disease, and the question of compensation might come in for consideration in such cases; but compensation should not be allowed the second time in the same herd.

THE LITERATURE OF BOVINE TUBERCULOSIS.

The literature of bovine tuberculosis is becoming quite voluminous. The Bureau of Animal Industry, U. S. Department of Agriculture, has published reports of original investigations on this subject, or items concerning it, in each of its annual reports since 1888; in its "Special Report on Diseases of Cattle" and in its Bulletins No. 3, 7 and 13. Similar investigations have been conducted by many of the Agricultural Experiment Stations of the United States and Canada, by state boards of health, and state live stock or tuberculosis commissions in America, and by similar commissions, or governmental agencies, in England and continental Europe. The publications of these commissions, as well as those of the experiment stations, are noted and frequently abstracted in the

Experiment Station Record, published by the Office of Experiment Stations, U. S. Department of Agriculture, and by the *Centralblatt für Bakteriologie, Parasitenkunde und Infektionskrankheiten, Erste Abteilung,* published by Gustav Fischer, Jena, Germany.

IN CONCLUSION.

The present status of our knowledge concerning bovine tuberculosis may be summarized as follows:

1. The disease is caused by the growth within the animal tissues of a vegetble organism, *Bacillus tuberculosis.*

2. The bacterium of bovine tuberculosis has not been specifically differentiated from that producing tuberculosis in the human subject.

3. Tuberculosis is produced in the lower animals by inoculation with tuberculous material from human subjects.

4. Tuberculosis has been produced in man by inoculations with the tuberculous material from cattle.

5. The development of tuberculosis in human subjects has followed in so many cases upon the use of the meat or milk of tuberculous cattle that there is no room to doubt that the disease is transmitted from cattle to man in this manner.

6. That tuberculosis is a germ disease, caused as surely by contagion or infection as are smallpox and measles, is confirmed not only by the innumerable cases in which it has spread through herds from single infected animals, but also by the fact that many herds of cattle remain exempt from it, and this fact demonstrates the possibility of entire eradication of the disease.

7. In view of the experience of other states it would seem that the rational method of extirpating bovine tuberculosis lies not in the wholesale and immediate testing of all the cattle of the state and the slaughter of all reacting animals, but in such municipal action as will control the sale of both milk and meat within municipal limits.